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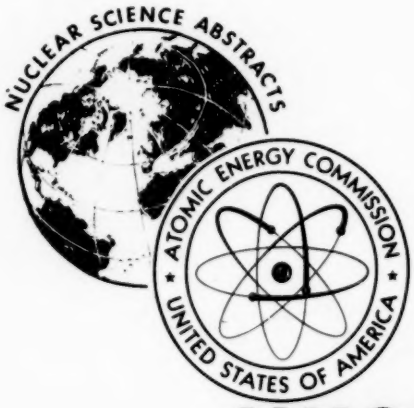

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Volume 18, Number 22, November 30, 1964

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Volume 18, Number 22 November 30, 1964

NUCLEAR SCIENCE ABSTRACTS

BIOLOGY AND MEDICINE

General

38717 (JPRS-26278) FLUORINE, IRRADIATION, AND TUMORS. Translated from Vopr. Rentgenol. i Onkol., No. 7, 145-53; 45-51; 199-204(1963). 24p. (TT-64-41537)

A separate abstract was prepared for one article. Other articles discuss the influence of fluorine on respiration and the transplantation of brain tumors. (C.H.)

For an abstract of the individual paper see: 38780.

38718 PATHOGENESIS OF LYMPH NODE LESIONS IN RUNT DISEASE. Norikazu Tamaoli (Keio Univ., Tokyo). Acta Pathol. Japon., 14: 61-74(Jan. 1964).

An analysis is made of the changes in lymph nodes which are considered to be primary lesion in the pathogenesis of runt disease and especially the role of the large mononuclear cells in the graft-vs-host reaction. Histopathologic changes are described in lymph nodes and related organs as produced by two types of immunologically competent cells, derived from spleen and thymus, which differ in capacity to elicit runt disease of mice. Donors were one- to two-month-old male mice of C57BL/6 strain, and in some instances the F_1 hybrid (C57BL/6 × C3H) was used. Recipients were of the C3H strain. In a strain combination C57BL → C3H, mice inoculated with homologous spleen cells showed the characteristic failure to gain weight from six days after injection, and most of them died between 11 and 14 days; on the other hand, among animals receiving thymus cells the incidence of runt disease was very low and death occurred rarely. Injected spleen as well as thymus cells caused proliferation of large mononuclear cells up to six days after inoculation. Marked depletion of lymphocytes, with reticulum cell hyperplasia, ensued in the animals injected with spleen cells, whereas repopulation of lymphocytes took place in those receiving thymus cells. Proliferation of large mononuclear cells was observed in the lymph nodes of the parental strain animals receiving F_1 hybrid spleen cells. Changes of thymus, spleen, liver, bone marrow and blood were mentioned. For an explanation of the pathogenesis of runt disease, the view is favored that the wasting syndrome after neonatal thymectomy in F_1 disease and runt disease is the consequence of depletion of host lymphoid tissue. Thus the concept of lymphoid aplasia is preferred to the mechanism based on a simple graft-vs-host reaction. (BBB)

38719 LAMINAGRAMS OF THE THOROTRAST-OPACIFIED LIVER IN EVALUATION OF CHEMOTHERAPY FOR METASTATIC CANCER. R. W. Talley, A. K. Poznanski, J. H. Heslin, and M. J. Brennan (Henry Ford Hospital, Detroit). Cancer, 17: 1214-19(Sept. 1964).

The use of Thorotrast as a contrast medium for radiographic studies of the liver and spleen is definitely limited to patients with a short life expectancy because of the known carcinogenic action of thorium dioxide. However, with the increasing interest in recent years in the development of chemical agents that will modify the course of metastatic carcinoma, the accurate evaluation of serial changes in size of hepatic metastases is very important. With the technique of laminagraphic studies of the Thorotrast-opacified liver, the evaluation of response to hormonal therapy or chemotherapy in patients with a variety of neoplasms metastatic to the liver has become accurately quantitative. However, it should be emphasized that because of the hazards associated with Thorotrast, its use should be confined to those patients who have known metastatic disease either in the liver or elsewhere. The use of this technique in our hands has proved to be superior to rose bengal–^{131}I liver scanning for the purpose of serial studies of hepatic neoplasia. In a series of 289 patients, this technique has proved highly reliable in demonstrating hepatic metastases and for subsequently following these patients during courses of hormonal or chemotherapeutic management. The patients who had demonstrable regression of hepatic metastases after therapy had a significantly longer survival period than the group who did not experience an objective decrease in hepatic metastases. (auth)

38720 VARIATION OF THE LEUKOCYTES NUMBER IN NORMAL AND HEALTHY PEOPLE. ITS IMPORTANCE IN THE FIELD OF RADIATION WORK. E. Bazzano and E. Ghislandi (Laboratori CISE, Milan). Energia Nucl. (Milan), 11: 379-83(July 1964). (In Italian)

The inconsistency of the literature values of leukocytes per mm^3 of circulating blood is discussed, and it is found that 6.96% of clinically healthy people exhibit a persistent leukopenia while 3.14% present a persistent leukocytosis. Investigation on the variation of the leukocyte density mean value during seven consecutive years, for a homogeneous sample consisting of 40 individuals, has shown statistically significant differences. The percentage of leukocyte counts below 5000 per mm^3, with respect to the overall counts performed yearly, during the period 1957 through 1963 has a maximum in 1957 (41.81%) and a minimum in 1959 (9.49%), an average value for the other years being about 20%. Possible reasons for such phenomena are briefly discussed: this discussion strongly supports the need for establishing suitable ground rules to judge the fitness for radiation

work, which should be flexible enough from the viewpoint of the clinical normality. (auth)

38721 USING RADIOISOTOPES TO STUDY PLANT GROWTH. Emilio Levi (Euratom ITAL Assn., Wageningen, Netherlands). Euratom Bull., 3: No. 3, 12-14(Sept. 1964).

The importance of using radioisotopes in plant growth studies and the activities of Euratom/ITAL in this endeavor are discussed. Fertilizer application, contamination problems, and crop production are areas toward which studies of physiological processes are aimed. (H.M.G.)

38722 AN EXPERIMENT DEMONSTRATING THE SAFETY AND POTENCY OF X-IRRADIATED DICTYOCAULUS VIVIPARUS VACCINE IN CALVES. Harlen J. Engelbrecht (Fort Dodge Labs., Kansas). J. Parasitol., 42: 21(Aug. 1961).

Calves 6 to 8 weeks old were treated as follows: (1) Ten received 1000 irradiated Dictyocaulus viviparus larvae (40,000 R) and were killed at intervals ranging from 42 hours to 29 days after vaccination. No gross lesions attributable to the vaccination were noted. One larvae was found in one calf. (2) Five were given 1000 nonirradiated larvae and were killed 42 hours, 90 hr, and 29 days after being dosed. No larvae were found at 42 and 90 hr; but 71, 379, and 134 lungworms were found in those killed at 29 days. (3) Seven were given two doses of 1000 irradiated larvae (40,000 R) with an interval of 30 days between doses. They were killed at intervals ranging from 2 to 29 days after the second dose. No gross lesions attributable to the vaccination were noted; a lungworm was found in one calf. (4) Three calves received two doses of 1000 nonirradiated lungworm larvae with 30 days between doses. One died 29 days after the second dose; the other two were killed on the 29th day after the second dose. Severe pneumonia was found in all three, and no lungworms were found. (5) Five calves received two doses of 1000 irradiated larvae (40,000 R) and were challenged with 4000 nonirradiated larvae. Very few gross lesions were noted; an average of 3.8 lungworms per calf were found in the lungs 31 days postchallenge. (6) Three untreated controls were challenged, and extensive pneumonic lesions were noted 31 days postchallenge. An average of 636 lungworms per calf was found in the controls. (BBB)

38723 ADVANCES IN MEDICAL SCANNING. D. Bruce Sodee (Doctors Hospital and Reener Clinic Foundation, Cleveland Heights, Ohio). Nucleonics, 22: No. 9, 47-51 (Sept. 1964).

Some advances in scanning agents and instrumentation are summarized, including the use of radioalbumin aggregates, ^{125}I-labeled agents, ^{75}Se methionine, ^{197}Hg compounds, and radioiodinated fibrinogen as scanning agents and the use of x-ray image amplifiers and spark chambers for radioisotope detection and measurement. (D.C.W.)

38724 RADIOACTIVE LABELING IN THE STUDY OF INSECT PESTS. S. V. Andreev, V. A. Molchanova, B. A. Martens, and A. A. Rakitin. Vestn. Sel'skokhoz. Nauki, Vses. Akad. Sel'skokhoz. Nauk, No. 2, 122-8(1964). (In Russian)

The laboratory has suggested a method of labeling insects (bugs and butterflies) with radioactive isotopes to study their biology. (auth)

38725 THE LET DISTRIBUTION OF DOSE IN SOME TISSUE CYLINDERS. W. S. Snyder (Oak Ridge National Lab., Tenn.). p.3-19 of "Biological Effects of Neutron and Proton Irradiations. Vol. I." Vienna, International Atomic Energy Agency, 1964.

When neutrons irradiate a tissue phantom, the recoil nuclei that are produced have a continuous spectrum of energies. Even in the case of monoenergetic neutrons, there will be continuous distributions of energy for the various recoil nuclei and, hence, also a continuous distribution of dose with respect to LET. Using a Monte Carlo-type program for the Controlled Data 1604 Computer, the LET spectrum of dose from monoenergetic beams of neutrons has been computed for tissue cylinders simulating a mouse, rat, guinea pig, dog, and man. Tissue was considered to consist of H, C, N, and O, in the proportions given for standard man. The H cross-sections used followed BNL-325 closely, and the cross-sections for O, N, and C were taken from NDA 2111-3, Vol. A; ORNL-2389; and NDA 12-16, respectively. The case of a phantom irradiated by the modified fission spectrum used by Neary is computed also. The LET distributions so obtained are used, together with values of RBE recommended by ICRP, to provide some interpretation of biological effects of neutron irradiation. These distributions are compared with data on biological effects of neutrons from some experiments and support, at least in part, some of the prevalent ideas concerning the dependence of RBE on LET, e.g., presence of repair and oxygen effect primarily with dose in low ranges of LET. Although these interpretations must be considered as preliminary, these LET distributions provide a basis for further experimental tests of the relation of RBE and LET. (auth)

38726 THE MEASUREMENT OF ENERGY DEPOSITED AT DEPTH IN TISSUE FOR AN INCIDENT Pu–Be SPECTRUM. D. E. Watt, R. C. Lawson, and J. H. Martin (United Kingdom Atomic Energy Authority, Chapelcross, Annan, Scotland). p.21-34 of "Biological Effects of Neutron and Proton Irradiations. Vol. I." Vienna, International Atomic Energy Agency, 1964.

The distribution of absorbed dose at depth in tissue due to recoil protons, ^{14}N(n,p)^{14}C and H(n,γ)D events produced by incident-collimated beams of neutrons from a Pu–Be source were determined using thermal-neutron and Bragg-Gray type detectors allied to pulse-counting techniques. The experimental results are compared with theoretical values for broad-beam irradiation. (auth)

38727 NEUTRON AND GAMMA DOSIMETRY IN THE BIOLOGICAL CAVITY OF NRX. B. J. Banville (Atomic Energy of Canada Ltd., Chalk River, Ont.). p.91-101 of "Biological Effects of Neutron and Proton Irradiations. Vol. I." Vienna, International Atomic Energy Agency, 1964. (In French)

The NRX reactor at Chalk River was equipped with a biological cavity for the experimental irradiation of biological material with slow neutrons. The high intensity of gamma radiation in the thermal beam is sharply reduced by bismuth shielding (average thickness 18 cm) which entirely surrounds the biological cavity. The internal dimensions of the cavity are 18 cm in height and 10 cm in diameter. The neutrons in the biological cavity are predominantly thermal neutrons, as can be seen from the ratio of captures by gold with and without cadmium (>3000). When the reactor is operating at maximum power, the mean slow-neutron flux is 9×10^8 n/cm^2 s. The neutron-flux densities are obtained by activating calibrated gold or manganese detectors or else derived from the currents obtained by passing carbon dioxide and nitrogen in turn through a graphite ionization chamber. In the case of prolonged irradiation, the total neutron flux is obtained by measuring the activity of cobalt wires which are placed in the cavity along with the biological specimens that are being irradiated. The mean intensity of the gamma-radia-

tion field in the biological cavity is 145 R/hr. This can be further reduced to 95 R/hr merely by placing a removable bismuth lining in the cavity, though this of course reduces the available space. The gamma-exposure doses are measured by means of a graphite-CO_2 ionization chamber insensitive to thermal neutrons. The gamma radiation and the neutron-flux density vary considerably, depending on the position inside the cavity and inside the organisms that are being irradiated. The various factors which may lead to error when measuring the exposure dose and dose absorbed during irradiation are analyzed. (auth)

38728 IN VIVO AND AIR DOSIMETRY OF FISSION-SPECTRUM NEUTRONS. T. S. Mobley (Kirtland Air Force Base, N. Mex.), R. E. Engel, W. R. Godden, and V. T. Penikas. p.103-16 of "Biological Effects of Neutron and Proton Irradiations. Vol. I." Vienna, International Atomic Energy Agency, 1964.

In an attempt to estimate the depth-dose pattern during exposure to fission-spectrum neutrons, a method of in vivo neutron dosimetry in the sheep was developed. A pulsed-reactor assembly similar to the Los Alamos Scientific Laboratory's GODIVA II was used for these studies. The reactor was pulse operated producing a 50-μs pulse width at half-maximum pulse height and a fuel-material temperature rise of about 100°C. A subcutaneous pack contains a cadmium-covered gold foil, a bare gold foil, and three thermoluminescent glass-rod dosimeters in a glass-lined lithium–lead container. The packs were placed in the subcutaneous tissue on both sides of the body to detect the integrated thermal-neutron flux and gamma dose as the neutrons are delivered broadside. Abdominal packs are prepared in a manner similar to the subcutaneous ones and consist of a boron ball containing cadmium covered fission threshold foils (Pu, Np, U) a sulfur tablet, and the three types of dosimeters included in the subcutaneous pack. The dosimetry pack was placed in the abdomen of the experimental animals eighteen hours before exposure. The pack is attached to the anterior pillar of the rumen. A Rumenotomy technique is described. The neutron dose was determined by means of threshold-foil measurements. Gold and cadmium-covered gold were used for determining the integrated thermal flux; plutonium-239, neptunium-237, uranium-238, and sulfur-32 for determining the integrated fast-neutron fluxes; and radiophotoluminescent glass rods for determining the gamma dose. The sheep received lateral exposures at a midline distance of two hundred centimeters or one hundred seventy five centimeters from the center of the critical assembly. The neutron rad dose measured in air at 200 cm was 161 ± 5.5 rad; at 175 cm the neutron dose was 242 ± 16.6 rad. The gamma dose at the respective distances were 33 ± 2.4 and 42 ± 2.5 r. The entrance and exit doses as well as the dose to the internal package varied with burst temperature rise, distance from the reactor, orientation of the foils with respect to the reactor, and the thickness and composition of the attenuating tissues. (auth)

38729 MEASUREMENT OF NEUTRON PENETRATION BY TISSUE ACTIVATION. D. Hightower and H. M. Swartz (Walter Reed Army Inst. of Research, Washington, D. C.). p.141-55 of "Biological Effects of Neutron and Proton Irradiations. Vol. I." Vienna, International Atomic Energy Agency, 1964.

A technique was developed which permits determination of neutron penetration in tissue without the addition of dosimetric devices or the use of tissue-equivalent material. This should eventually permit a better experimental determination of depth dose. In addition, it will permit one to determine neutron-dose gradients across organs and in other areas of biological significance such as bone marrow. The technique is based on determining the sodium-24 in tissue samples removed from intact frozen-animal cadavers exposed to a neutron flux. After the activity has decayed to an insignificant level, the tissue section is reactivated with a standard, the amount of the sodium in the tissue section determined, and the original data corrected. Determination of other radioisotopes activated in the tissue, possibly by threshold reactions, should permit one to evaluate better the neutron interaction phenomena in tissue when it is exposed to a neutron flux. Data, graphs, and radioactographs are presented to illustrate the applicability of this technique to different neutron spectra. In addition, comparison is made to purely theoretical determinations of neutron penetration. (auth)

38730 A METHOD OF BIOLOGICAL MEASUREMENT OF THERMAL- AND FAST NEUTRON DOSES ABSORBED BY LIVING ORGANISMS. J. Chanteur, P. Pellerin, and Y. Arnaud (Service Central de Protection Contre les Rayonnements Ionisants, Fontenay-aux-Roses, France). p.157-65 of "Biological Effects of Neutron and Proton Irradiations. Vol. I." Vienna, International Atomic Energy Agency, 1964. (In French)

After exposing young rats to a high thermal neutron flux the activated zones were determined by autoradiography at −195°C. The localization and nature of some of the activated elements were studied. Attention is drawn to the important role of ^{32}P compared to other activation products. The authors compare the doses resulting from direct exposure to the neutron flux with those associated with local irradiation of bone and other tissue as a secondary effect of activation. The next step is the study of the possibility of using microbiopsy of bone tissue as a precise means of evaluating absorbed-neutron dose a posteriori in terms of different parts of the organism and different neutron energies by measurement of the samples' specific ^{32}P activity for thermal neutrons and calculation of the specific ^{31}Si activity for fast neutrons. (auth)

38731 THE RELATIONSHIP BETWEEN BLOOD INJURY AND ABSORBED DOSE IN CRITICALITY ACCIDENTS. J. A. Dennis (Atomic Energy Research Establishment, Harwell, Berks, Eng.). p.167-80 of "Biological Effects of Neutron and Proton Irradiations. Vol. I." Vienna, International Atomic Energy Agency, 1964. (AERE-R-4413)

The neutron and gamma doses to individuals exposed in criticality accidents have been recalculated to yield the surface-absorbed dose to the trunk of the body. The relationship is examined between this dose estimate and blood-count profile scores that are based on the scoring system of N. Wald and G. E. Thoma for deviations from the normal of the lymphocyte, neutrophil, and platelet-peripheral blood counts. It is shown that a quantity based on the surface-absorbed gamma dose and the ^{24}Na activity in the blood shows a better correlation with the blood-count profile score and is a better prognostic guide for the degree of radiation injury than any of the conventional dose estimates. The relative biological effects data of the heavy-particle recoil doses deduced from these observations are consistent in general with values obtained from experiments on dogs. (auth)

38732 PATTERNS OF LETHALITY AND ABSORBED DOSE DISTRIBUTIONS IN MICE FOR MONOENERGETIC NEUTRONS. N. A. Frigerio and D. L. Jordan (Argonne

National Lab., Ill.). p.117-28 of "Biological Effects of Neutron and Proton Irradiations. Vol. I." Vienna, International Atomic Energy Agency, 1964.

The presence of strong C, N, and O resonances in the 100 to 1500 kev region permitted the study of specific neutron-nuclide interactions as reflected in lethality, RBE maxima, etc. Sixty-two μA of resolved Van de Graaff protons, 1882 to 2738 kev, yielded monoenergetic neutrons via $^{7}Li(p,n)^{7}Be$. Virgin female CF-1 mice were exposed in celluloid capsules to the monoenergetic neutrons at distances of 3.1 to 11.3 cm from the source at laboratory angles of 0 to 1 radian. Mice were exposed bilaterally while simultaneously in motion through either circular or elliptical orbits normal to the axis of the beam. Thus, control of dose distribution within the animal was possible. Absolute flux measurements were made with ^{235}U fission counters and by absolute counting of Au wires and foils activated within Cd covers. Patterns of dose absorption were measured with micro-ionization chambers and with a specially developed $FeSO_4$-NH_4SCN dosimeter of high sensitivity. Relative dose measurements were made with Hurst proton-recoil gas counters and ^{10}B, ^{6}Li, and proton-recoil scintillators. Neutron-energy distributions were measured with specially developed ^{10}B, ^{3}He, and ^{6}Li gas and solid-state spectrometers. Gamma contributions were measured with Ne/Ar chamber counters. These measurements showed gamma contribution to be less than 0.8%, and thermal-epithermal less than 0.01%, of the total rad dose. Animals were exposed to median midpoint doses ranging from 180 to 1200 rad at neutron energies from 396 to 658 kev ± 50 kev to cover the region of N and O resonances. Levels and patterns of lethality proved to be strong functions of neutron energy and equally strong, but independent, functions of dose distribution. Regardless of dose, energy or distribution, however, all animals surviving five days survived at least 144 days, dying then of the usual long-term effects. This suggests that monoenergetic fast neutrons, free of gamma and epithermal contaminations, produce the early intestinal death almost exclusively. (auth)

Ecology

38733 INFLUENCE OF THE SUPPLY OF STABLE STRONTIUM IN THE SOIL ON THE STRONTIUM CONTENT OF CULTIVATED VEGETABLES. USE OF ACTIVATION TECHNIQUES AND OF γ SPECTROMETRY. C. Myttenaere and R. Kirchmann (CEN, Mol, Belg.). Physiol. Plantarum, 15: 656-62(1962). (In French)

Ray grass (Lolium italicum) and red clover (Trifolium pratense) were grown in Ca- and Sr-poor sandy soil. Samples of dry material were calcined and activated along with Sr standards. After removal from the reactor, they were chemically purified. The results indicate that addition of Sr to the soil increases the Ca content of the vegetation. The ratio of Sr/Ca was higher in ray grass than red clover sampled during the first season. The superficial root system of the grass favors absorption of Sr from the soil surface; subsequent plowing of the soil prior to the second season increased the absorption of Sr by red clover. (TCO)

38734 RADIOACTIVE ISOTOPES AND ALGAE. G. V. Barinov. Priroda, No. 7, 82-3(July 1964). (In Russian)

The selective absorption of elements by algae and the study of this process by radioactive tracers is discussed. The equilibrium exchange times for Ulva rigida in sea water were calculated to be: ^{45}Ca, 1 min.; ^{137}Cs, 320 hours; ^{144}Ce, 217 hours. The practical importance of selective absorption studies is found in consideration of contamination of the oceans and in evaluation of effects of this on their ecology. (TTT)

38735 STRONTIUM AND CALCIUM UPTAKE BY THE GREEN ALGA, OOCYSTIS EREMOSPHAERIA. Niles R. Kevern (Oak Ridge National Lab., Tenn.). Science, 145: 1445-6(Sept. 25, 1964).

The uptake of calcium and strontium by a green unicellular alga cultured in media containing these elements in concentrations found in nature is directly proportional to the concentration in the media. Variation in the concentration of either element has a slight inverse influence on the uptake of the other. The increase of strontium uptake when the calcium concentration is very low indicates that strontium is substituted for calcium when calcium is limited and suggests that the alga requires either element. (auth)

Metabolism, Tissue Distribution, and Toxicology

Refer also to abstract 39633.

38736 (ANL-6887) THE DETERMINATION OF INORGANICALLY BOUND IODINE-131 IN URINE. William D. Fairman (Argonne National Lab., Ill.). June 1964. Contract W-31-109-eng-38. 23p.

Inorganically bound iodine-131 is separated from other urinary constituents by ion exchange on a silver chloride column. After removal as iodic acid from the column by acidified chlorine water, the iodine is subjected to two oxidation-reduction solvent-extraction cycles and finally precipitated as silver iodide. The mounted precipitate is beta and/or gamma counted. Chemical and radiochemical yields are 87.2 ± 1.5%. Total time for the procedure (exclusive of counting time) is approximately two hours for a single sample. Tracer interference experiments show that silver, chloride, bromide, and mercury exchange onto the silver chloride, but these elements are removed in the elution and extraction steps. The other elements studied, cadmium, cerium, antimony, ruthenium, tellurium, molybdenum, and technetium, do not exchange onto the silver chloride. (auth)

38737 DISORDERS OF CALCIUM METABOLISM INVESTIGATED WITH STRONTIUM. L. De Somer, J. Coenegracht, and M. Dorleyn (St. Annadal Hospital, Maastricht, Netherlands). Acta Med. Scand., 175: 653-62 (May 1964).

The rate of Ca deposition in bone and the size of the exchangeable Ca pool cannot be measured satisfactorily by means of classical balance studies. Therefore, use has been made recently of various isotopes, including ^{45}Ca. This isotope, however, has the disadvantage of being a weak β emitter, which makes it difficult to measure in vivo, and moreover it also has a long half-life of 152 days. Calcium-47 is a γ emitter with the short half-life of 5 days, which should make it the ideal isotope for this type of investigation, but it is difficult to produce and frequently contains an appreciable quantity of ^{45}Ca. Strontium-85 has a half-life of 65 days and, being a strong γ emitter, is easily measurable in vivo. Although Sr is excreted by the kidney at a rate three to eight times that of Ca, skeletal tissue does not appear to discriminate between these two elements. It is possible, therefore, to use this isotope in the investigation of Ca metabolism in a variety of pathologic conditions and

in various stages of diseases, before and after treatment. In the present investigations, 20 to 50 μC of ^{85}Sr was administered intravenously to 60 subjects. Radioactivity in serum and urine samples was measured with the aid of a well-type scintillation detector. By means of these tracer doses of ^{85}Sr, increased values for the exchangeable Ca pool and bone accretion rate were found in conditions such as Paget's disease, thyrotoxicosis, and acromegaly. Two patients with hyperparathyroidism without radiologically diagnosable bone lesions had normal bone accretion rates. Almost normal values were also found in cases of senile osteoporosis. Five of the six patients with essential hypercalciuria had low bone formation rates. Patients with osteoblastic bone metastases showed an increased rate of bone deposition; in cases of osteoclastic secondaries the bone accretion rate was found to be elevated in several patients with a severe degree of bone involvement, whereas it was usually normal when the extent of bone invasion was slight or moderate. It is concluded that this ^{85}Sr test may be of value in judging the degree of activity of bone disease and in evaluating the effect of therapy. A compartmented body model is described and theoretical considerations presented whereby an isotope such as ^{85}Sr may be used to evaluate the distribution of the body's constituent elements. (BBB)

38738 A THEORETICAL ANALYSIS OF RADIOSTRONTIUM METABOLISM AND DEPOSITION IN HUMANS. Fredrik C. Gran and Ragnar Nicolaysen (Univ. of Oslo). Acta Physiol. Scand., 61: Suppl. 223, 1-37(1964).

With available data on the calcium (Ca) content of the human body and present knowledge of Ca and ^{90}Sr physiology as a basis, the body/diet (O.R.) was calculated from birth to adult age. Different sets of values for O. R. were obtained by varying the values for Ca-intake or digestive juice Ca (by varying the true Ca-absorption), and by using different values for O. R. (absorption). The formulas used and an example of the details in the calculations have been given, allowing for corrections should other values prove to be more correct. Assuming a constant ingestion of ^{90}Sr in proportion to Ca from the time of birth to adult age, a maximal value for O. R. is reached at one year of age. Next this ratio declines by about 20 to 50 per cent in the course of the following ten to twenty years. The O. R. may be as high as 0.6 on low Ca diets. Such a value may also be reached in some children living on high Ca-intakes equal to the recommended allowances in U.S.A. The reason is that O. R. (absorption) may be higher than the usual average of 0.5 which results in a final O. R. of 0.25. When ^{90}Sr ingestion starts in children at increasing age the final O. R. is reduced. The values calculated in children below the age of ten years are considerably higher than the values calculated in the older children; the values for O. R. decline fairly sharply after the age of ten years under such circumstances. The values for the concentration of ^{90}Sr in the diet of the eastern United States for the nine-year period 1953 to 1961 were used in one set of calculations. This resulted in a set of values for ^{90}Sr-concentrations in human bones from the age of one to twenty years which agree fairly well with the values obtained by direct analysis of the ^{90}Sr content in human bone samples collected from the same region. (auth)

38739 THYROID RADIOACTIVITY AFTER ^{131}I TREATMENT. W. J. Kaipainen (Univ. of Helsinki). Ann. Med. Internae Fenniae, 52: 11-19(1963).

Study was undertaken to: follow the retention of ^{131}I radioactivity in the thyroid to ascertain its causal relation with factors known at the time the dosage was decided upon; and establish the effect of various drugs, such as potassium perchlorate, 2-carbethoxy-thio-1-imidazole, and potassium iodide, on ^{131}I retention of the thyroid and urinary excretion of ^{131}I. After treatment of 30 patients with 5 to 10 mC ^{131}I, the radioactivity of the thyroid was measured daily for 8 days. The radioactivity of the dose to be given was measured on the day of administration with a scintillation counter at a distance of 2 m; the activity remaining in the dosage bottle served as a control for later measurements on the patient, also performed at 2 m. The 24-hr uptake of the treatment dose was taken as 100% when the 8th day radioactivity was determined. The results showed no correlation between the residual eight-day radioactivity of the therapeutic dose and the serum cholesterol level. Attempts at correlation of the residual eight-day radioactivity and protein-bound iodine (PBI) showed that there were three groups of patients. In the largest group the PBI values were low when the activity retained in the thyroid was also low; the correlation is almost linear. Another group had a low PBI originally and a high eight-day radioactivity. No correlation between the eight-day activity of the therapeutic dose and the consistency and size of the thyroid was seen. The effect of potassium perchlorate and 2-carbethoxy-thio-1-imidazole (CMI) separately and in combination on the residual ^{131}I radioactivity of the thyroid was measured. It was noted after 8 days that an average of 76.5% of the original treatment uptake had been retained in the thyroid in the cases in which no medication was given after ^{131}I. The use of CMI as after-treatment for radioiodine therapy is discussed, and it is concluded that it is to be recommended because it helps to avoid a continuous state of thyrotoxicosis while the radioiodine treatment begins to exert an effect. If symptoms of thyrotoxicosis reappear, when CMI is withdrawn, it is easier to judge whether another dose of radioiodine is needed. (BBB)

38740 STUDIES OF ISOTOPE DISTRIBUTION IN TRITIATED PYRIMIDINES. Robert M. Fink (Univ. of California, Los Angeles). Arch. Biochem. Biophys., 107: 493-8(Sept. 1964).

Consistent estimates of the amount of tritium bound at the C-5 position of uridine were obtained by studying the isotope exchange rate in 1 N H_2SO_4 at 100°C and by preparing various derivatives in which substituents replaced the tritium at C-5 (thymidine, 5-bromouridine, and a Mannich product). In a commercially tritiated uridine preparation, the tritium bound at C-5 represented approximately 97% of the total and showed an exchange half-life of 0.5 day in the hot acid. The remaining 3% of the tritium, bound at C-6, was retained through 2 weeks of acid treatment, introduction of substituents at C-5, and hydrolytic removal of the ribose moiety. Cytidine-^{3}H exchanged its tritium with the hot acid slowly (50% in 6 days), but it could be converted to uridine for isotope distribution analysis. The C-5 position held 88 to 91% of the tritium in one cytidine preparation and approximately 98% in another. In a commercial uracil-^{3}H preparation the tritium bound at C-5 (99% of the total) showed an exchange half-life of 0.1 day in the hot acid, while uracil-6-^{3}H was acid-stable. Experiments with uracil-1,3-^{3}H indicated that tritium bound to ring nitrogens exchanges rapidly with water, even at a pH near neutrality. (auth)

38741 BIOLOGICAL HALF LIFE AND TURNOVER RATE OF IODINE 131 IN THE WHOLE BODY OF THE RAT. H. C. Heinrich, E. E. Gabbe, and D. H. Whang (Universitat, Hamburg). Atomkernenergie, 9: 279-81(July-Aug. 1964). (In German)

Iodine-131 whole-body retention and excretion was stud-

ied in rats after oral and intraperitoneal application of 0.7 μC carrier-free $Na^{131}I$. A whole-body radioactivity detector with a liquid organic scintillator and a 4-π counting geometry was used for the measurement of ^{131}I in the rats and their excreta. About 52% of the absorbed or intraperitoneally injected ^{131}I anions left the rats with a biological half life of 6 to 7 hours mainly via urinary excretion. This half life was therefore considered to represent the turnover of the inorganic iodide. Metabolic equilibrium between the retained ^{131}I and the whole-body iodine pool was obtained four days after the ^{131}I uptake. The biological half life of the retained iodine reached 9.5 days then and remained constant at this level, representing the turnover of the organic iodine. About 36% of the ^{131}I dose left the rat with a final biological half life of 9.5 days mainly via fecal excretion. From the iodine whole-body content of rats (10 μg) and the measured biological half life of iodine in rats (9.5 days) a whole-body rate (= nutritional iodine requirement) of 0.7 to 0.9 μg iodine/day or 7 to 9% of the iodine pool per day was calculated. (auth)

38742 LABELLING OF HUMAN FIBRINOGEN WITH ^{131}I BY ELECTROLYTIC IODINATION. U. Rosa (Sorin-Centro Ricerche Nucleari, Saluggia, Italy), G. A. Scasselati, F. Pennisi, N. Riccioni, P. Giagnoni, and R. Giordani. Biochim. Biophys. Acta, 86: 519-26(June 8, 1964).

An original method for labeling proteins with radioactive I is described, and its application to the ^{131}I iodination of human fibrinogen is illustrated. The method is based on the electrolysis of a solution of $K^{131}I$ in presence of the protein to be labeled. The labeling procedure and the electrolytic cell are described in detail. The product thus obtained does not show modifications of its original characteristics, as judged from electrophoresis in agar and from the values of the turnover-time which were obtained in a group of normal human subjects. (C.H.)

38743 ACID-BASE DENATURATION OF DNA IN HEAVY WATER. R. N. Maslova, V. V. Grechko, and Ya. M. Varshavsky (Inst. of Radiation and Physico-Chemical Biology, Moscow). Biochim. Biophys. Acta, 87: 314-25(June 22, 1964).

Investigations of DNA solutions from phage T_2 of Escherichia coli demonstrated different states of stability of DNA to acid and base denaturation in H_2O and ^2H_2O. Critical values of pH and p^2H that strongly affect the structure of DNA have been determined: in the acidic region, 50% denaturation corresponds to pH = 2.65 and p^2H = 3.05; in the alkaline region, the figures are 11.30 and 11.70, respectively. The dissociation constant of the —NH—CO— guanosine group in ordinary and heavy water has been determined by spectrophotometrical titration and found to be 9.2 and 9.7, respectively. Comparison of differences in dissociation constants of —NH—CO— and $-NH_2$ groups in native DNA molecules and in free nucleotides, in both ordinary and heavy water, suggested that the observed differences in the stability of DNA to acid and base denaturation were mainly due to the difference in the dissociation constants of these groups in H_2O and ^2H_2O. (auth)

38744 EXTRACELLULAR PATHWAYS IN THE PERIPHERAL NERVE FIBRES: SCHWANN-CELL-LAYER PERMEABILITY TO THORIUM DIOXIDE. Gloria M. Villegas and Raimundo Villegas (Instituto Venzolano de Investigaciones Cientificas, Caracas). Biochim. Biophys. Acta, 88: 233-5(July 29, 1964).

The permeability to thorium dioxide of the spaces separating adjacent plasma membranes in the peripheral nerve fibers was studied in the squid and the frog. Isolated stellar nerves of the squid (Doryteuthis plei) and sciatic nerves of the frog (Rana pipiens) were incubated in artificial sea water and Ringer-Conway medium, respectively. Thorium dioxide was added to produce final concentrations of 9% in the sea water and 8% in the Ringer-Conway medium. Electron micrographs showed that ThO_2 particles were found in: the Schwann cell channels and the axon-Schwann cell space of the squid giant nerve fibers; the mesaxon gap and the axon-Schwann cell space of the medium and small size unmyelinated fibers of the squid; the mesaxon gap and the axon-Schwann-cell space of the unmyelinated fibers of the frog; and the Ranvier-node gap of the frog myelinated fibers. (H.M.G.)

38745 UPTAKE, TURNOVER AND EXCRETION OF I-131 BY RAINBOW TROUT (SALMO GAIRDNERI). J. B. Hunn and P. O. Fromm (Michigan State Univ., East Lansing). Biol. Bull., 126: 282-90(Apr. 1964).

Data on the 24-hr tissue distribution of intraperitoneally injected $Na^{131}I$ indicate that the gills of trout do not accumulate iodide above the concentration found in the blood. In contrast, the lower jaw (thyroid tissue) exhibits ability for concentrating iodide which is inhibited by thiocyanate. In addition to blocking thyroidal uptake of radioiodine, administration of thiocyanate reduced the ^{131}I content of both blood and gill tissue. The ^{131}I content of the aquarium water 24 hr after injection showed that the rate of loss from the thiocyanate-treated fish was approximately three times that of control fish (control 21.9% and NaSCN treated 69.7% of the injected dose). Data on the relative distribution of ^{131}I in blood plasma following intraperitoneal injection are also given. Less than 5% of the total radioiodide in the blood was found in the protein-bound fraction, and the amount decreased along with a decrease in the non-bound iodide until the fifth day after injection when it increased slightly, presumably the result of thyroidal production and/or release of radioactive thyroxine. Thyroidal (lower jaw) radioiodine showed a continual rise during the five-day experimental period. The very short biological half life of 1.7 days indicates a very rapid rate of turnover for non-bound ^{131}I in trout plasma. Its rate of disappearance from the plasma is a function of tissue exchange (addition and withdrawal) and excretion (renal and extrarenal). A special apparatus, which is shown, was constructed to facilitate study of routes and rates of excretion of ^{131}I from fish. Urine/plasma ratios determined with this apparatus indicated that the trout kidney is efficient in reabsorbing ^{131}I from the glomerular filtrate. The outflux of ^{131}I from the gills, measured simultaneously with urinary excretion, indicated that 3.8 times more iodide is excreted by the kidney than by the gills per unit of time. These data obtained in the trout are discussed in relation to those reported for other fish and for higher animal species. (BBB)

38746 PREPARATION OF RADIOACTIVE BIOCHEMICALS BY USE OF YEAST. Louis Laufer, Sidney Gutcho, Thomas Castro, and Ruth Grennen (Schwarz BioResearch, Inc., Orangeburg, N. Y.). Biotechnol. Bioeng., 6: 127-46 (June 1964).

Methods for obtaining ^{14}C-labeled compounds, of a wide variety, are outlined. Sugar molasses of high specific activity was prepared by photosynthesizing $^{14}CO_2$ into sugar in a leaf of the Canna plant and then extracting the sugar. When Torula utilis is grown in such a medium, about 45% of the radioactivity is incorporated into the yeast cell; the remaining radioactivity is CO_2 and volatile organic compounds. The cells are now randomly labeled in all carbon compounds. Distribution of ^{14}C in the major cell compo-

nents, such as protein, polysaccharide, and nucleic acids is shown. Nucleic acid is extracted from the cells and subjected to chemical and enzyme action for the preparation of randomly labeled ribonucleotides. Proteins are isolated and hydrolyzed to yield high specific activity amino acids, up to 150 mC/mole. Similarly, polysaccharides are also isolated and from them high specific activity glucose and mannose are obtained by acid hydrolysis. By growing T. utilis in a medium containing ^{14}C-8-adenine and ^{14}C-2-uracil, these bases are about 90% incorporated into the nucleic acids of the cell. By use of the same methods described for the uniformly labeled nucleic acid, only base-labeled nucleosides and nucleotides can be prepared. The base-labeled RNA extracted from the yeast serves as a source of numerous important specifically labeled nucleosides and nucleotides, such as adenosine triphosphate, cytidine triphosphate, inosinic acid, adenosine 5'-phosphate, adenosine, cytidine, and uridine. The methods used for obtaining these involve well-known published procedures, such as enzymic degradation, phosphorylation, ion exchange, and paper chromatogram separations. A flow chart is shown for the preparations of ^{14}C-labeled 5'-, mono-, di-, and triphosphate nucleosides from yeast RNA. Preparative procedures for the isolation of some of these compounds are discussed. The latest biochemical techniques for their purification are described. Methods for assaying for radiochemical purity and problems concerning stability of high specific activity of the compounds are discussed. (BBB)

38747 LABELING OF SERUM PROTEINS WITH ^{131}I BY MEANS OF CHLORAMINE T. PRELIMINARY NOTE. V. Bocci (Università, Siena, Italy). Boll. Soc. Ital. Biol. Sper., 40: 89-93(Jan. 31, 1964). (In Italian)

Bovine serum protein was labeled in vitro with ^{131}I, using chloramine T as an oxidizing agent. After 2 or 30 min the reaction was stopped by the addition of metabisulfite and carrier iodide, and the unincorporated ^{131}I was removed on an ion-exchange column. Better results were obtained after 30 min, when 60 to 70% yields of active serum protein were obtained with small amounts of chloramine T (0.4 mg/100 mg protein). Bovine and rabbit sera labeled in this fashion or with ICl did not show changes by autoradiography of electrophoretograms; no variations in the distribution of the activity between the components was noted. Doses of ^{131}I-serum proteins were injected into the marginal vein of nine male adult rabbits and blood samples removed from the other ear. Tables of results for four typical experiments are compared: The rate and degree of turnover were calculated to be 26.0 ± 3.4% and 1.78 ± 0.61 g in 24 hr for proteins labeled using ICl, and 26.4 ± 2.1% and 1.48 ± 0.38 g in 24 hr for proteins labeled using chloramine T. Specific activity of the two preparations was about equal (40 μC/mg protein); but ICl produced a ratio of 0.5–1 atom I/mol protein, while chloramine T gave a ratio of 1 to 2 × 10^3 mol protein. The distribution and catabolism of these preparations in the rabbit are graphed and followed to 450 hr as total body activity, extravascular activity, intravascular activity, and activity of urine. This labeling method gives greater efficiency, reproducible results, and is carried out easily. (BBB)

38748 RADIOIODIDE METABOLISM IN AMPHIUMA AFTER ITS INTRAPERITONEAL ADMINISTRATION. John W. Moule and Paul Foley Nace (McMaster Univ., Hamilton, Ont.). Can. J. Physiol. Pharmacol., 42: 623-6 (Sept. 1964).

Using a new adaptation of the clinical neck–thigh method, the thyroid uptake of radioiodide (^{131}I) after intraperitoneal administration was measured in the urodele Amphiuma means. The technique permitted extended serial determinations in vivo in the same animal and showed that the thyroid uptake did not reach a maximum until 8 to 9 days. When the thyroid mechanisms were blocked by an excess of iodide, the renal excretion of radioiodide was found to be almost an exact replica of the normal thyroid uptake. The significance of this finding to the use of the intraperitoneal route in urodeles is discussed. (auth)

38749 REDISTRIBUTION OF RADIOACTIVE ASSIMILATES IN LEAF TISSUES OF CEREALS. N. A. Pristupa (Timirazev Inst. of Plant Physiology, Moscow). Fiziol. Rast., 11: No. 1, 38-42(1964). (In Russian)

Redistribution of radioactive assimilates in maize and barley leaves was studied by microradioautography. The microradioautographs were obtained by gluing lyophil-dried paraffin sections onto dry photographic plates. After 5 or 10 minutes of photosynthesis in an atmosphere containing $^{14}CO_2$, most of the activity in a detached maize leaf was found in the chlorophyllous cells of the lining of small bundles. In intact maize leaves which photosynthesized 20 minutes in $^{14}CO_2$, the radioactive assimilates entered the conducting vessels of the small bundles and 120 minutes after termination of photosynthesis they accumulated in the phloem of the large bundles. In barley leaves radioactive assimilates after 20 minutes photosynthesis are uniformly distributed in the mesophyll and do not accumulate in the lining cells. It is suggested that predominant accumulation of radioactive assimilates in the lining of small bundles is a reflection of enhanced photosynthesis in them. (auth)

38750 METABOLISM OF IODINE AND FORMATION OF IODOTHYRONINES (T_3 AND T_4) IN THE COURSE OF REGENERATION OF THE TUNIC IN AN ASCIDIAN, CIONA INTESTINALIS. Jean Roche, Giuseppe Rametta, and Stelio Varrone (Collége de France, Paris). Gen. Comp. Endocrinol. 4: 277-84(June 1964). (In French)

An attempt was made to dissociate the process of iodination of scleroprotein fibers in the outer cuticular layer of the tunic from the process of biosynthesis of thyroid hormones in the subjacent layer in detunicated C. intestinalis. Fixation of ^{131}I from sea water by fully detunicated or intact Ciona was compared in experiments conducted 4½ days at 15°C. The ^{131}I concentration by Ciona, practically stopped by detunication, resumes after 36 hours and increases during the three following days, along with the regeneration of the tunic. Free monoiodotyrosine (MIT) and diiodotyrosine (DIT) are present in n-butanol extracts of homogenates after 2½ days; they are accompanied later by thyroxine (T_4), characterized by chromatography. Enzymatic hydrolyzates of tissues previously extracted by n-butanol contain, after 4½ days of regeneration, MIT, DIT, triiodothyronine (T_3), and T_4. These results confirm that biosynthesis of thyroid hormones occurs in Ciona. (BBB)

38751 EXAMINATION FOR AND DETERMINATION OF Sr^{90} IN DECIDUOUS AND PERMANENT TEETH. M. Zanetti, F. Cutrufelli, L. Pettenella, and S. Damilano (Università, Bologna). Giorn. Igiene Med. Prevent., 4: 85-90(1963).

The results of an investigation for qualitative and quantitative determination of ^{90}Sr in deciduous and permanent teeth are reported. ^{90}Sr levels in the different specimens showed a good correlation between the concentration of ^{90}Sr and the period of calcification. It is concluded that this type of investigation is useful not only for the facility of finding sufficient material but also because it is possible to assess

approximately the contamination at the period of calcification. (Excerpta Med., Sect. XXIII, 1: (Aug. 1964))

38752 CALCIUM AND STRONTIUM TURNOVER IN MAN. J. F. Loutit (Medical Research Council, Harwell, Berks, Eng.). Irish J. Med. Sci., No. 427, 283-302(July 1961).

Interrelations in the metabolism of Ca and Sr, particularly as concerns their concentrations in blood and bone as affected by the age-dependent maturation of bone, are extensively discussed. Some differences between Sr and Ca in the diet are discussed. The relation between Ca/Sr ratios in plasma and gut, and the incorporation of Sr by bone and its renal excretion are also considered. Evidence indicates that the percentage retention of a Sr dose is about the same in children and adults, but from data on feces it is inferred that the fraction of the dose absorbed is less in children. (OTS)

38753 FACTORS AFFECTING THE ESTIMATION OF IODINE ENTERING THE NORMAL THYROID GLAND USING SHORT-TERM CLEARANCE STUDIES. T. H. Oddie, D. A. Fisher, and J. M. Long (Univ. of Arkansas, Little Rock). J. Clin. Endocrinol. and Metab., 24: 924-33 (Sept. 1964).

Experiments on euthyroid subjects given trace doses of ^{131}I demonstrate that the renal clearance rate for radioiodide decreases at night by a factor of about 1.4 compared with the day-time value, whereas the thyroidal clearance rate remains approximately constant. This factor, and losses of iodide in sweat, feces, and uncollected urine must be taken into account when the results of short-term radioiodine studies are used to estimate the thyroidal accumulation of stable ^{127}iodide. (auth)

38754 INFLUENCE OF SODIUM INTAKE ON EXCHANGEABLE SODIUM IN NORMAL HUMAN SUBJECTS. Paul I. Jagger, Gerald J. Hine, John A. Cardarelli, and Belton A. Burrows (Massachusetts Memorial Hospitals, Boston; Boston Veterans Administration Hospital; and Boston Univ.). J. Clin. Invest., 42: 1459-70(1963).

Long-term studies of sodium metabolism in five normal subjects were carried out by use of tracer doses of ^{22}Na and measurement of body radioactivity to make repeated exchangeable sodium determinations. Body sodium exchanging after the first 24 to 48 hours was not a significant fraction of the metabolically active sodium pool, nor did it interfere with long-term measurements of this pool by isotope dilution methods. Exchangeable sodium was shown to vary directly with changes in sodium intake. A small fraction of the tracer doses of ^{22}Na was shown to have a prolonged biological half-life consistent with its incorporation within bone crystals. (auth)

38755 MUSCLE BLOOD FLOW IN NORMAL MAN AND IN PATIENTS WITH INTERMITTENT CLAUDICATION EVALUATED BY SIMULTANEOUS Xe^{133} AND Na^{24} CLEARANCES. N. A. Lassen (Bispebjerg Hospital, Copenhagen). J. Clin. Invest., 43: 1805-12(Sept. 1964).

Muscle blood flow was evaluated by simultaneously injecting ^{24}Na and ^{133}Xe into the anterior tibial muscle in ten normal subjects (20 normal legs) and ten patients with intermittent claudication (17 symptomatic legs). Studies were made at rest and during maximal reactive hyperemia after ischemic work. Comparison of the clearances of the two isotopes indicated marked diffusion limitation of ^{24}Na at high blood flow levels and demonstrated that ^{133}Xe allowed a much clearer separation between normal and pathological cases than ^{24}Na. The results obtained with ^{24}Na relative to ^{133}Xe would seem to invalidate clearance data for ^{24}Na as a measure of capillary flow except at very low flow levels. During hyperemia the capillary diffusion capacity for Na is rate limiting to an increasing extent. These findings also invalidate attempts to employ ^{24}Na or ^{131}I clearance measurements of a dual circulation in skeletal muscle. (auth)

38756 RADIOACTIVE SULFUR FOR PROTEIN SEDIMENTATION DETERMINATIONS. C. V. Morr (Ohio State Univ., Columbus). J. Dairy Sci., 47: 646-8(June 1964).

A study was conducted to determine the effect of heating synthetic skim milk upon the sedimentation characteristics of both the caseinate and serum proteins by utilizing labeled proteins. Radioactive milk was obtained by intravenous injection of ^{35}S-labeled cystine into a cow and collecting the milk over the first 24-hr period. Findings agree with electrophoretic and ultracentrifugal sedimentation results that β-lactoglobulin interacts preferentially with the smaller-sized caseinate micelles upon heating skim milk and also indicates that the present, radioactive approach offers promise for differentiating caseinate and serum protein sedimentation characteristics. (TCO)

38757 UPTAKE OF RADIOACTIVE BERYLLIUM, VANADIUM, SELENIUM, CERIUM, AND YTTRIUM IN THE TISSUES AND TEETH OF RATS. P. R. Thomassen and H. M. Leicester (Univ. of the Pacific, San Francisco). J. Dental Res., 43: 346-52(May-June 1964).

The distribution of ^{7}Be, $^{48}V + ^{49}V$, ^{75}Se, ^{139}Ce, and ^{88}Y (all injected as the chloride salts) in the tissues and teeth of 30-day-old Osborne-Mendel rats was studied. Results showed that all the elements studied can be taken up by the developing molars and incisors of rats when injected in weak acid solutions. With these elements, when there was an extensive uptake by such tissues as the liver and spleen, there was also an uptake by the teeth, and in the case of the molars, there is a continued retention of nearly constant amounts of the elements for prolonged periods. (BBB)

38758 RADIOSENSITIVITY AND BIOLOGICAL PROPERTIES OF TWO TUMOR TYPES INDIGENOUS TO THE SAME HOST. VIII. CATALASE ACTIVITY WITHIN THREE INTRACELLULAR FRACTIONS AND ITS RESPONSE TO VARIOUS CHEMICAL AGENTS. Leo A. Miller and Anna Goldfeder (Dept. of Hospitals, New York and New York Univ., New York). J. Natl. Cancer Inst., 33: 27-32(July 1964).

The distribution of intracellular catalase activity of the mitochondrial, microsomal, and cell-sap fractions of the slower-growing epithelial, and the faster-growing spindle cell tumors, both indigenous to the same inbred strain of mice, was investigated. Livers from the same strain of mice were used as normal test material for controls. The catalase activity of the epithelial tumor was approximately 7 times greater than that of the faster-growing spindle cell tumor on a wet-weight basis. The catalase-specific activity of the epithelial-tumor mitochondrial fraction was approximately 5 times greater than that of the spindle cell tumor. The catalase activity of the combined fractions of the liver was 100 times greater than that of the epithelial tumor and 722 times greater than that of the spindle cell tumor on a wet-weight basis. The high percentage of catalase activity in the cell-sap fraction of the spindle cell tumor relative to that of the epithelial tumor is explained by the greater permeability or fragility of catalase-containing particles of the spindle cell tumor. Other indications of a difference in mitochondrial integrity of the two types of tumor are discussed. The response of

catalase to pretreatment with 1.25 M sucrose, deoxycholate, and phosphate buffer at pH_2 was investigated for both tumors and the liver. The catalase of the mitochondrial fraction was increased about threefold, the cell-sap catalase was unaffected, and the microsomal catalase activity was slightly increased by pretreatment with the above chemical agents. The large increase in the catalase activity of the mitochondrial fraction is believed due to the release of this enzyme as a result of the injurious effects of these agents on the boundary membrane of the catalase-containing particle. (auth)

38759 EFFECT OF DEUTERIUM OXIDE ON THE GROWTH OF PEPPERMINT. II. HISTOLOGICAL EFFECTS. F. A. Crane, M. I. Blake, R. A. Uphaus, and J. J. Katz (Univ. of Illinois, Chicago). J. Pharm. Sci., 53: 612-16(June 1964).

The leaf, stem, and root of peppermint plants (Mentha piperita) grown in 70% D_2O nutrient were examined microscopically and comparison of the significant histologic features was made with comparable sections from plants grown in an aqueous nutrient. All plants were harvested after 50 days, at which time the controls went into the flowering stage. Results indicate that D_2O exerts its effect on the growth of peppermint by inhibiting cell division, presumably as a result of the disturbance of the rates of enzymatically controlled biosynthetic reactions. Parenchyma cells generally are enlarged with consequent changes in leaf and stem dimensions and other structural effects. Vascular tissue is reduced in the deuteriated plants, and the effects are more pronounced in growing tissues than in tissue exposed to D after differentiation occurs. (BBB)

38760 COMPARATIVE ELECTRONOPTIC STUDY OF THE SUBSTANTIA COMPACTA OF THE TIBIAL DIAPHYSIS OF NORMAL, STRONTIUM-PSEUDORACHITIC AND RACHITIC RATS, AND OF A RACHITIC CHILD WHO HAD DIED IN TETANY. G. Wilhelm and G. Lippert (Universität, Frankfurt am Main). Monatsschr. Kinderheilk., 110: 217-20(Mar. 1962). (In German)

Earlier hypotheses of the calcification process emphasized Ca and P exchange as the main factor. Rachitis, where calcification of the skeleton is markedly reduced, was therefore viewed predominantly as being due to a lack of these elements. The humoral events, intestinal resorption of Ca and P, and their excretion by the kidneys, were, in this view, of prime importance. More recently, it has been shown that there is a great difference between calcification and precipitation of Ca and P salts. Bone crystal formation is not simply a function of solubility products. In rickets the extracellular fluid is more than saturated with Ca and P salts, and crystal nuclei, once they are formed, will grow. The older hypothesis that crystal formation, brought about by local increases of phosphate ion concentrations until supersaturation, results in deposition of secondary Ca phosphate is untenable. Electron microscope studies of Sr-rachitic bone from a child that had died in tetany showed that, interspersed among areas of normal bone, there were numerous irregular areas of calcification foci within homogeneous masses where isolated bone crystals could be seen. This was similar to the picture seen in rats given a Sr-rich, Ca-deficient diet, where the collagenous ground substance was formed with only a few collagen fibrils, but where there was no apatite deposition. In Sr pseudorachitis the bone may have a latent capacity to calcify, but this becomes evident only when Ca becomes available. Apparently the ground substance is altered in rickets. Formation of the fibrils is closely related to acid chondroitin sulfate metabolism, and if this is impaired, crystal formation may not take place in a normal way. (BBB)

38761 FACTORS AFFECTING CALCIUM-45 AND STRONTIUM-85 TRANSFER IN THE LAYING HEN. D. Drori (National and Univ. Inst. of Agriculture, Rehovoth, Israel), R. Volcani, Y. Feige, E. Shalmon, and N. Passy. Poultry Sci., 43: 486-91(Mar. 1964).

Experiments were carried out to obtain information on the effect of dietary factors, methods of isotope administration, and the incidence of egg-laying on the ^{45}Ca and ^{85}Sr deposition in the egg shell, on changes in the observed Sr/Ca ratio as a result of absorption and deposition, and on the elimination of ^{85}Sr in the excreta of chickens. White Leghorn hens were fed diets consisting of a standard layers' mash containing 3.5% Ca, with or without supplements of Sr. Seven days after the hens were on these experimental diets, a double tracer dose containing one μC of ^{85}Sr and three μC of ^{45}Ca was administered. Dietary supplementation with stable Sr, with and without Mg, Ba, Na_2SO_4, soybean oil, and/or vitamin D, had relatively small effects on the rate of deposition and excretion of the radioisotopes. Of the ^{45}Ca dose, 63 and 74% appeared in the first egg laid within 24 hours of dosing, in crop and intravenously dosed hens, respectively. The comparable values for ^{85}Sr were 52 and 69%. The correlation between ^{45}Ca and ^{85}Sr in the same eggs was 0.90 and 0.69 after crop and intravenous injections respectively. The major source of variation in ^{85}Sr excretion on the first day and in combined elimination in eggs and excreta over seven days of the study was the occurrence of laying within 24 hr of dosing; beginning on the third day after dosing hens which laid on the first day deposited ^{85}Sr at half the rate of hens which failed to lay on the first day. ^{45}Ca in eggs followed the same pattern. The ratio of $^{85}Sr/^{45}Ca$ passing the blood-egg barrier was 0.927 and the ratio for the gut-blood barrier was 0.882. Because of the uncertainty in the occurrence of laying on any given day and variation in the time of shell formation when laying occurs, the discontinuous administration of tracers to layers instead of continuous feeding will always produce highly variable results. (BBB)

38762 THE APPLICATION OF RADIOISOTOPES TO THE PHARMACODYNAMIC STUDY OF PROTEINS AND POLYPEPTIDES. Jacques Ingrand (CEN, Saclay, France). Prod. Pharm., 18: 229-44(May 1963). (In French)

Methods are reviewed for protein and polypeptide labeling by ^{131}I, ^{35}S, and ^{51}Cr. Tables of reported replacements by chemical, exchange, and biosynthetic means are given, and additions of the isotopes given above are also tabulated. Choice of a labeling method depends on several factors. Attention is directed to the identification of the protein under study before and during the experiment. The use of isotopes in the study of action of growth hormone, prolactin, corticotropin, thyrotropin, vasopressin, glucagon, and insulin is reviewed. Intercellular distribution of ^{131}I-insulin in the nuclei, mitochondria, microsomes, and remainder is 10, 26, 32, and 33%, respectively; that found for ^{131}I-serum albumin was 6, 7, 10, and 74%; and that for $Na^{131}I$ was 6, 5, 5, and 89%. The use of thyronines and various iodothyronines labeled with ^{131}I and T is also reviewed. The distribution of ^{51}Cr-cytochrome c after injection in the rat is tabulated for 4 hr and 7 days. Studies with trypsin and heparin are also reviewed. (BBB)

38763 ISOTOPE EFFECTS IN FULLY DEUTERATED HEXOSES, PROTEINS AND NUCLEIC ACIDS. J. J. Katz,

H. L. Crespi, and A. J. Finkel (Argonne National Lab., Ill.). Pure Appl. Chem., 8: 471-81(1964).

The results of experiments are described that are indicative of the range and scope of isotope studies that can be carried out because of the availability of fully deuterated substances produced by biosynthesis. Based on the results it is likely that all but the most fastidious microorganisms can be grown in fully deuterated media. Ascending the phylogenetic scale, a protozoan was grown in fully deuterated form. Studies of fully deuterated proteins and nucleic acids indicated that the presence of nonexchangeable deuterium weakens or lessens the degree of hydrophobic bonding in these molecules. Experiments in the utilization of deutero-glucose and deutero-mannose by ascites tumour cells revealed interesting isotope effects, from which conclusions on rate-limiting phenomena in metabolism can be based. The deuterium isotope effect with the hypothesis that the conversion of mannose 6-phosphate to fructose-6-phosphate is the rate-limiting step in the degradation of this sugar to lactate. (P.C.H.)

38764 MITOSIS AND MACROMOLECULE SYNTHESIS IN CELLS EXPOSED TO D_2O. P. R. Gross, W. Spindel, and G. H. Cousineau (Brown Univ., Providence; Rutgers State Univ., Newark, N. J.; and Marine Biological Lab., Woods Hole, Mass.). Pure Appl. Chem., 8: 483-97(1964).

Changes in the mechanical properties of the cytoplasm that follow upon deuteration are described, along with observations on deuterium parthenogenesis. Experimental data concerning protein synthesis and its uncoupling from RNA synthesis are summarized, and attempt was made to bring the experimental data within the framework of the general descriptive hypothesis. Cytologic observations of sea urchin eggs while in D_2O revealed that they remain in the mitotic state at which they entered heavy water. Experiments on gelatin showed that a slight change in the strength of a D-bond, compared with an H-bond, can, through the co-operative interactions of many such bonds distributed along a polymer chain, cause a large net shift in the mechanical properties of the solution or gel, in the sense that intermolecular crosslinks become favored over hydrogen bonds to solvent. When Arbacia eggs were suspended in D_2O sea water, 80% showed at least one cleavage furrow within 35 min of their return to normal water. (P.C.H.)

38765 DOSE-DETERMINED EFFECTS OF HT_3DR AS DNA LABEL UPON THE LIVER CELL REPLICATION TIME AND PATTERN IN THE GROWING RAT. J. Post and J. Hoffman (New York Univ., New York). Pure Appl. Chem., 8: 499-505(1964).

Studies were made of the effects of different dosage levels of tritiated thymidine (H^3TDR), as a DNA label, upon the replication pattern and time of liver cells in the growing rat. The dose-dependent effects are disruption of the regular, evenly-spaced replication cycles, lengthening of the generation time and of the DNA synthesis time, increased variation of the respective time intervals of the replication cycle of the cells of the population, marked delay in the transition of many cells through DNA synthesis and reduction in the number of cells in mitosis. The last two effects contribute to the previously reported radio-induced polyploidy. All of these effects are similar to those previously reported to follow gamma and x-radiation. No cell necrosis was observed. The measurement of the replication time offers a useful technique in the study of the biological effects of radiation. (P.C.H.)

38766 FACTORS WHICH INFLUENCE THE CONCENTRATION OF ^{131}I BY THE SUBMAXILLARY GLAND OF THE C3H MOUSE. J. L. Llach and J. H. Tramezzani (Instituto de Biologia y Medicina Experimental, Buenos Aires). Rev. Soc. Arg. Biol., 37: 93-8(Aug.-Sept. 1961). (In Spanish)

As compared with intact animals, an increase in concentration of ^{131}I in the submaxillary gland was observed in castrated male mice. Experiments were carried out to determine whether this increase in ^{131}I content after castration could be caused by a decrease in saliva secretion. The effect of fasting and of various drugs capable of affecting salivary gland secretory activity was also studied. One group of C3H mice was deprived of food for 48 hr prior to ^{131}I administration. Other groups received subcutaneous injections of atropine (1 mg/animal) and pilocarpine (1.5 mg/animal) almost simultaneously with injections of ^{131}I 90 min prior to the mice being sacrificed. In another group the effect of anesthesia by ether and Nembutal (7.5 mg/100 g body wt) on ^{131}I concentration of the gland prior to decapitation was studied. Results showed that ^{131}I concentration in the gland increased in fasting mice and in those receiving injections of atropine and Nembutal; no change was observed with ether anesthesia, and in pilocarpine-treated animals ^{131}I concentration decreased. The inhibitory action on salivary secretion of atropine and Nembutal through blocking of salivary gland parasympathetic innervation is well known as well, as is the converse excititory action on the gland by pilocarpine. Therefore, it was concluded that an inverse ratio exists between volume of salivary secretion and ^{131}I concentration. (BBB)

38767 IODINE-125 DISTRIBUTION BETWEEN FOLLICULAR COLLOID AND COLLOID DROPLETS IN MOUSE THYROID GLAND. Walter C. Bauer and John S. Meyer (Washington Univ., St. Louis, Mo.). Science, 145: 1431-2 (Sept. 25, 1964).

Radioautographs of tissue from the thyroid gland prepared 24 hours after the administration of ^{125}I showed that the concentration of radioactivity in intracellular colloid droplets was the same as that in the follicular colloid. This observation indicates that colloid droplets are due to phagocytosis of small portions of follicular colloid. (auth)

38768 A SIMPLIFIED INDICATOR-DILUTION TECHNIQUE FOR FEMORAL ARTERY FLOW MEASUREMENT IN MAN. John T. Hobbs and Edward A. Edwards (Peter Bent Brigham Hospital, Boston). Surg. Forum, 13: 239-40 (1962).

An improved isotopic method for measuring blood flow is presented in which the radiation hazard from the use of radioiodinated human serum albumin (RISA) is diminished. After injection of RISA into the femoral artery the concentration-time curve is followed by a continuous recording of the curve instantly drawn. A lightweight and simplified apparatus was constructed for the use of ^{125}I-labeled serum albumin. An automatic injector delivers a predetermined dose (contained in 1 or 2 ml) of RISA in 0.25 sec. The recorded graph may be either logarithmic or linear. Logarithmic is preferable in the quantitative studies since it allows direct extrapolation of the disappearance slope of the primary circulation requisite for the calculation of flow. The following information is obtained: cardiac output, total femoral artery flow, flow after vasodilatation maneuvers, total blood volume, circulation times, and limb blood volume. (BBB)

38769 PERMEABILITY OF THE VASCULAR TISSUE BARRIERS OF THE EAR, NOSE AND THROAT ORGANS TO RADIOACTIVE PHOSPHORUS (P^{32}) AFTER SEVERE

BLOOD LOSS. V. F. Filatov (Khar'kov Medical Inst.). Vestn. Otorino-Laringol., No. 3, 105-6(May-June 1964).

Experiments were carried out on 36 rabbits (15 of them as controls) to observe the permeability of vascular tissue barriers to ^{32}P at intervals of 2, 12, and 24 hours after loss of 25% of the blood supply. Penetration of ^{32}P from blood to tissue was determined by calculation of the concentration of isotopes in the blood and in tissue suspensions of the organs studied. It was found that blood loss affects the state of reactivity of the ear, nose, and throat organs, including the permeability of the vascular tissue barriers. After 2 hours an increased concentration of ^{32}P was observed in tissues of the tongue, esophagus, larynx, and trachea, and a decreased accumulation of it by the salivary gland and palatine tonsils. No change was noticed in the tissues of the glottis and concha nasalis inferior. The concentration of ^{32}P had decreased considerably in all these organs 12 hours after loss of blood. Absorption of ^{32}P by the palatine tonsils and the salivary gland had sharply decreased. Increased absorption by the concha nasalis inferior was observed. After 24 hours normalization of the distribution of ^{32}P was observed in the palatine tonsils, glottis, esophagus, and larynx; increased accumulation was observed in tissues of the tongue, salivary gland, trachea, and concha nasalis inferior. (OTS)

38770 THE INFLUENCE OF SULFUR-CONTAINING RADIATION-PROTECTION MATERIALS ON THE METABOLISM OF HISTAMINE. I. THE ACTION OF SH- AND DISULFIDE COMPOUNDS ON THE ENZYMES OF HISTAMINE DECOMPOSITION. J. E. Pany (Universität, Vienna). Z. Ges. Exptl. Med., 137: 609-18(1963). (In German)

The action of the radioprotectant sulfhydryl compounds β-aminoethylisothiuronium chloride (AET), cysteine, cysteamine, cystine, and cystamine on the histamine content of the small intestine of the mouse was studied. Addition of SH compounds in vitro and in vivo was found to block enzymes which catabolize or alter histamine; disulfides which act as radioprotectants have no effect. The interference is dependent on the concentration of the SH compound, as was shown previously with respect with their ability to protect animals against lethal irradiation. (TCO)

38771 CYTOLOGICAL AND HISTOCHEMICAL STUDIES OF DENERVED KIDNEYS INJECTED WITH RADIOACTIVE PHOSPHORUS (^{32}P). K. A. Zufarov and D. Kh. Khamidov (Lab. of Radiation Cytology, USSR). p.64-70 of "Radiatsionnye Effekty v Biologicheskikh Sredakh i Organizmakh i Metody ikh Issledovaniya." Tashkent, Publishing House of the Sciences, 1964. (In Russian)

Cytological and histological studies were made of structural and functional changes of denerved kidneys injected with ^{32}P. After denervation the uptake of ^{32}P by the epithelium is much more intense than in controls. After 24 and 72 hr, autographs indicate enhanced metabolic processes; this was also confirmed by histochemical studies. A small number of epithelium cells (2 months later) showed inhibited metabolic processes, primarily related ribonucleo proteins, a weakening color in the pyroninophyl substances, pharmasone grains, and indophenol blue. The experiments with incorporated ^{32}P show a progressive weakening of urine-forming functions of degenerative kidney due to inhibited nephron function. It was concluded that the afferent link of the nervous system (peripheral sensitive neurons) is a necessary element for retaining structural integrity and normal functions. (R.V.J.)

38772 FACTORS AFFECTING THE DESIGN OF A $C^{14}O_2$ NONRECIRCULATING CHRONIC INHALATION APPARATUS FOR SMALL ANIMALS. David L. Joftes (New England Deaconess Hospital, Boston). 17p. (CONF-561-5)

From Symposium on Inhaled Radioactive Particles and Gases, Richland, Wash., May 1964.

A study was undertaken on the effects of ^{14}C on spermatogenesis in mice that will breathe $^{14}CO_2$ chronically. It is intended to arrange a system in which mice will fix sufficient $^{14}CO_2$ so that a gonadal dose of 2.5×10^{-3} Rad/g will be reached in a few weeks. This dose is the equivalent of the 0.1 R male gonadal dose that it is estimated is accumulated by humans in 30 years. The construction of two constant environment chambers in which such exposures can be safely made is described. (P.C.H.)

Radiation Effects

38773 (CONF-648-1) POPULATION DYNAMICS OF DAPHNIA PULEX AS MODIFIED BY RADIATION STRESS. J. S. Marshall (Michigan. Univ., Ann Arbor). [nd]. Contract AT(11-1)-1005. 14p.

From American Society of Limnology and Oceanography 27th Annual Meeting, Miami Beach, Fla., June 1964.

Populations of Daphnia pulex were exposed for an average of 19 hrs/day to different intensities of external, ^{60}Co γ radiation, and were cultured in media that provided a constant daily food ration for each population. Data on 25 populations observed for 385 days indicated that within the entire range of indefinitely tolerable dose rates the population consequences of radiation stress, as determined with Daphnia, stem almost entirely from effects on individual fecundity, fertility, and survivorship. (C.H.)

38774 (EUR-1881.e) APPLICATION OF ATOMIC ENERGY IN AGRICULTURE. Annual Report, 1962. (Netherlands. Instituut voor Toepassing van Atoomenergie in de Landbouw, Wageningen). 1964. 35p.

Facilities of the Institute for Atomic Sciences in Agriculture, Wageningen, the Netherlands, include the Biological and Agricultural Reactor of the Netherlands (BARN), chemical laboratories, and facilities for plant breeding studies. The facilities are described and illustrated by photography. Progress is reported in studies of the mutagenic effects of neutrons, x radiation, and γ radiation, and various chemicals in beans, peas, tomatoes and potatoes, the uncovering and re-arranging of radioinduced chimeras of chrysanthemum and rose varieties to induce color changes; the radiation processing of strawberries, raspberries, and cherries to increase storage life; factors affecting the metabolism of ^{45}Ca and ^{85}Sr by plants, the movement of ^{90}Sr through soils, the effects of Ca content of grass on ^{90}Sr content of milk from grazing cows, the effects of ^{90}Sr accumulation in geese in their natural environment, and the foliar absorption and distribution of ^{32}P, ^{86}Rb, and ^{134}Cs in bean plants as demonstrated by macro-autoradiographic techniques. (C.H.)

38775 (ORO-624) SEMI-ANNUAL PROGRESS REPORT [ON RADIOBIOLOGY], JULY 1–DECEMBER 31, 1963. (Tennessee. Univ., Oak Ridge. UT-AEC Agricultural Research Lab.). Contract AT(40-1)-GEN-242. 140p.

Progress is reported on the status of burros surviving: neutron-gamma irradiation from an atomic detonation on September 14, 1957; gamma radiation from isotopes of either ^{60}Co, ^{182}Ta, or $^{95}Zr-^{95}Nb$; or neutron irradiation from the Godiva Reactor. The history of each decedent during the report period is given for six swine exposed

to gamma-neutron irradiation from an atomic detonation. An eye malignancy in the one remaining Alamogordo cow is described. Cerebrospinal fluid (CSF) production was measured in irradiated and nonirradiated sheep. Protein requirement studies of growing burro foals are in progress on animals exposed to 250 R whole-body γ radiation at 135 days of age. Analysis of blood samples from the foals showed lower leucocyte, platelet, granulocyte, and lymphocyte counts from the 3rd through the 60th days postirradiation. Studies on the effects of chronic irradiation on sperm production in bulls; the effect of irradiation on lifetime fertility of cows; the effect of chronic irradiation on sperm production in boars; and the effect of early postnatal irradiation on gonadal development in rabbits were continued. Results of preliminary histological analysis of testes from bulls exposed to 300 to 1000 R doses of ^{137}Cs gamma rays are summarized. Studies were initiated to study the effect of prenatal irradiation on morphological development in lambs; the effects of level of maternal nutrition on embryonic and fetal development in sheep; the effect of unilateral ovariectomy and whole-body irradiation on the lifetime fertility of female rabbits; and the effect of maternal malnutrition and prenatal irradiation in pigs. When 0.5 or 1.0 mC doses of ^{144}Ce were administered to pregnant rats, the embryonic death loss was markedly increased in animals dosed on the 4th to 9th days of gestation. A greater number of spermatogonia was found in male rats given 1.5 ml of olive oil per 25 gm of body weight prior to 600 R whole-body irradiation. Radiation pathology studies directed toward the analysis of death patterns of irradiated animals through examination of necropsies were conducted in cattle, burros, sheep, swine, and rabbits. The radioinduced formation of specific substances was studied in the urine of two radiotherapy patients and in rats injected with substances crystallized from the urine of irradiated sheep. No specific alterations were noted in the rats. A significant increase of mammary tumors was evident in female rats when plasma or plasma ultrafiltrate from irradiated rats was injected at seven days of age, but there were no changes in the tumor incidence when female rats were injected at six months of age. Experiments were initiated to study hormonal influence on ^{65}Zn secretion by the pancreas in pigs and the metabolism of calcium and strontium in beef cattle. Growing pigs dosed intravenously with ^{45}Ca and ^{89}Sr at one and 21 days postirradiation were used to determine if the previously reported radioinduced ^{89}Sr retention was due to an increase in absorption or a decrease in re-excretion of ^{89}Sr. Microscopic examination of the gastrointestinal lining of sheep continuously fed $^{144}Ce-^{144}Pr$ showed no damage and gross observations showed only a severe fibrous and necrotic infiltration of the omasum. Investigation of sites of gastrointestinal-blood passage of iodine and thyroxine in young cattle was continued, and absorption values for various intestinal sites are reported. Metabolism of sodium iodide was compared with that of 3,5-diiodosalicylic acid in cows given ^{131}I-labeled diiodosalicylic acid (DIS) and $Na^{125}I$ plus ^{44}Ce twice daily for six days. Calf thyroid uptake of iodine was studied in milk dosed in vivo (in the cow) or in vitro (in the feeding bucket). When the two labeling methods were compared, there was no significant difference, indicating that when fed in the normal manner, milk protein bound iodine is metabolized as efficiently as free iodide added to the milk. Correlations between thyroid uptake, abomasal secretion, plasma iodine level, and protein bound iodide are discussed. Experiments are reported in which the effects of acute Ca, P, and Sr depletion by hemodialysis were studied in Hereford and Holstein calves. Other observations in dairy cattle indicated that high level whole-body gamma radiation had a minor effect, if any, upon lactation. Studies on the effect of irradiation on erythrocyte chimerism and immunologic tolerance in dizygotic cattle twins were continued. White Leghorn chick eggs were injected at various stages of incubation with ^{45}Ca, ^{147}Pr, $^{90}Sr-^{90}Y$, ^{35}S, Te, or Se; and abnormalities developing in the embryos were observed. Laying pullets were administered ^{89}Sr, ^{90}Y, ^{95}Nb, ^{99}Mo, ^{103}Ru, ^{131}I, ^{132}Te, ^{134}Cs, ^{140}Ba, ^{142}Pr, ^{144}Ce, ^{147}Nd, or ^{147}Pm either orally or intramuscularly (IM). The differences in fission product concentration in tissues and egg contents between IM and oral routes of administration were negligible for Cs, increasing in magnitude in the following order: Sr, I, Mo, Ba, Te, Pr, and Ru. Very little, if any, Y, Nb, La, Ce, Nd, or Pm was found in the tissues and eggs from hens receiving these elements orally. Uptake and retention of ^{45}Ca, ^{89}Sr, and ^{32}P were studied in growing hens. The $^{45}Ca/^{32}P$ uptake ratios were inversely related to stable Ca/P ratios, but neither the $^{89}Sr/^{45}Ca$ uptake ratios nor resorption from osseous tissue as measured by rate of deposition in egg shells were affected by previous calcium intake regardless of the length of the adaptation period. The rate of passage of ^{144}Ce was found to be slower in birds given 1000 R whole-body irradiation than in the controls. The rate processes for cation movement in Na and Sr bentonite with increasing levels of NaCl and $SrCl_2$ were investigated by electrical conductance measurements assuming an equivalent resistance model comprising three elements in parallel: a surface element, a series element between clay particles, and a solution element. Sodium bentonite at concentrations of 1, 2, and 3% was equilibrated with NaCl solutions, and emf and conductance measurements were made. The difference in emf between the two phases was the suspension effect of Donnan emf. Potentiometric, diffusion, and conductance measurements were made in two kaolinite samples to determine the reproducibility of rate limiting processes for ion exchange as compared with bentonite. The conductance and diffusion measurements indicated that the Na mobility is of the same order of magnitude as in bentonite. The effects of whole-body gamma irradiation on glucuronide excretion were studied in the urine of rats, and it was found that glucuronide excretion decreased with increasing radiation dose. An increase in glucuronide excretion noted on the second day postirradiation over that of the first day was observed to be of greater magnitude in nonirradiated rats administered 4% naphthalene in Mazola oil. The amount of iodine consumed by samples of urine (a test for mecapturic acid quantification) from rats receiving 1000 R dropped sharply after the second day. Although the excretion of mercapturic acid was low in the irradiated animals, it followed an exponential pattern started on the first day after dosing with naphthalene. Food consumption of rats irradiated with various doses of gamma rays was less on the 4th-11th days postirradiation in those animals receiving higher doses. Research was continued on plant embryo morphology and radiosensitivity. Embryonic features of 12 plant species are tabulated. Correlation analysis of embryo morphology and radiosensitivity revealed that cell volume and nuclear volume are exponential functions of dose, that the 50 per cent dose decreased as cell and nuclear volumes increased, and that other factors contributed much less to radiation response. Dose prediction estimates for 50% seedling growth reduction based

on nuclear volume and on cell and nuclear volumes are tabulated. Results indicate that differential species radiosensitivity of seeds is primarily determined by embryonic structure. A method for predicting dose-response of seeds from measurement of nuclear volume alone is presented. When relative humidity was plotted as the abcissa and relative radiation tolerance as the ordinate, it was indicated that seeds might be expected to be at their most resistant moisture level when equilibrated at 60% relative humidity, falling off symmetrically to 60% of such tolerance at 20 and at 100% relative humidity. Studies on the physiological and morphological effects of gamma irradiation on horticultural plants were expanded to include cuttings from Coleus and Eleagnus. Radioinduced mutation frequencies were scored in Hirsutum. There were no observed differences in number of induced changes for marker loci in toto between the two hybrids scored, but certain loci in each hybrid had a greater frequency of changes than others, indicating differences in site sensitivity. Quantitative mutations from seed irradiation were studied in cotton and soybeans. Dosimetry of a 1000-C ^{137}Cs source is described. Publications released during the period covered by the report are listed. (H.M.G.)

38776 (TID-19586) EFFECTS OF IONIZING RADIATION ON LIPIDS OF FISH. Final Summary for the Period November 1962–November 1963. Virginia F. Stout, Darryl D. Des Marteau, and Edward H. Gruger, Jr. (Fish and Wildlife Service. Technological Lab., Seattle). Nov. 1963. Contract AT(49-11)-2058. 22p.

The autoxidation of methyl docosahexaenoate, $CH_3(CH_2CH=CH)_6CH_2CH_2CO_2CH_3$, was studied as a means of elucidating the factors that cause or affect the rancidity of irradiated fish flesh. Two methods of sample preparation were compared to determine their effect on autoxidation. Tests were made to discover whether preexposure to oxygen sensitized the lipid toward oxidation. The autoxidation of the lipid in the presence of added ferrous, manganous, and cobaltous stearates was studied. Variations in the preparation caused only minor alterations in the stability of the lipid. A preliminary exposure to oxygen did not induce the formation of a powerful autoxidation catalyst in the substrate. The metal ions were much weaker catalysts under the conditions chosen than had been anticipated. Nevertheless in nearly all the experiments, irradiation increased the catalytic effect. Though in any one instance, the increase in autoxidation resulting from the metal ion was not large, the combination of several catalysts in a natural system such as fish flesh would probably interact in such a way that trace amounts of metal ions could be important catalysts of the rancidity in radiated fish flesh. (auth)

38777 (TID-21068) INVESTIGATIONS ON MUTABILITY OF POLYGENES AND ON UTILIZATION OF INDUCED GENETIC VARIABILITY. Progress Report, July 1, 1964. R. E. Scossiroli (Pavia, Italy. Università. Istituto di Genetica). Contract IAEA 61/US. 40p.

Progress is reported in studies of genetic effects of x radiation in maize and wheat. Emphasis was placed on radioinduced mutations of polygenes and on utilization of induced genetic variability in yield improvement. Data are included from selection experiments on the progenies of maize with tassels exposed to doses ranging from 500 to 3000 R and estimates of genetic variability in the R_3 and R_4 generations of Triticum durum and T. aestivium from irradiated wheat seed. (C.H.)

38778 (TID-21082) RESEARCH ON THE EFFECTS OF RADIATIONS ON BIOLOGICAL MOLECULES, OF AGGREGATES OF SUCH MOLECULES AND AGGREGATES WITHIN CELLS. Progress Report, November 1, 1963–August 31, 1964. Franklin Hutchinson (Yale Univ., New Haven). Contract AT(30-1)-2653. 43p.

Progress is reported in studies on the effects of radiation on biological molecules and extra- and intra-cellular aggregates of such molecules. Data are presented from studies on the behavior of Bacillus subtilis under different growth conditions and the development of techniques for the extraction and purification of DNA from the bacterial cells; the effects of molecular weight on transforming activity of pneumococcus; studies on the effects of heavy ions on mitotic delay and survival of Chinese hamster cells in tissue culture; and chromosome damage in hamster cells in culture after exposure to 8 different beams of accelerated nuclei or x radiation. (C.H.)

38779 (TID-21084) EFFECTS OF IONIZING RADIATION ON CONDITIONING. Final Report. W. T. James and L. J. Peacock (Georgia. Univ., Athens). [1963]. Contract AT(40-1)-2787. 28p.

No consistent and reliable relationship was found between radiation exposure and clasically conditioned responses in dogs on the basis of over 6000 presentations of positive and negative conditional stimuli to dogs intermittently irradiated with 18 to 25 rads γ radiation. Conditioned foreleg flexion and conditional salivary response magnitude were the conditioned responses tested. The discrepancy between the conclusions and those reached by various Soviet investigators are attributed to different frames of reference with regard to the statistical analysis of experimental data. (C.H.)

38780 (JPRS-26278(p.17-23)) THE INFLUENCE OF COMBINED IRRADIATION ON TISSUE RESPIRATION. S. G. Shukuryan. Translated from Vopr. Rentgenol. i Onkol., No. 7, 199-204(1963).

Suppression of tissue respiration in rat livers and spleens induced by chloroprene intoxication or whole-body exposure to 800-R x radiation was intensified by their combined action. It was concluded that peroxides are involved in the mechanism of action of x radiation against a background of chloroprene intoxication. (C.H.)

38781 THE ULTRASTRUCTURE OF NORMAL AND EXPERIMENTALLY ALTERED SPINAL GANGLION CELLS: A STUDY OF THE LUMBAR SPINAL GANGLIA OF RATS. Karl Hermann Andres (Uppsala Univ.). Abstr. Uppsala Dissertations Sci., 17: 1-22(1964). (In German)

The pattern of acute radiation damage and mechanical cell injury produced by toxic reactions is typified by widespread extension of endoplasmic reticulum, vacuolar transformations of the mitochondria, and retraction of the ganglion cell nuclei. This corresponds to the condition of severe ganglial cell disease observed with the light microscope. However, light microscopy often is unable to differentiate true pathological conditions from artifacts. Electron microscopy can resolve these effects, and, moreover, shows cytoplasmic and nuclear edema in addition to structural changes in the cell organelles. Sometimes in borderline cases it is impossible to discern the differences between the pathological and the artificial responses. The time of appearance of changes in the various tissue and cell changes is so variable that it is difficult to ascribe causal relations between the radiation exposure and the injury. Nevertheless, with the electron microscope it is possible to establish that the neural elements are damaged

primarily by the radiation itself, and not as the result of secondary effects due to damage to the vascular system. This is shown by the fact that characteristic structural changes are seen in nuclei of the spinal ganglia within 2.5 to 4.5 hr after exposure to protons, while injuries to the capillary system appear only after an interval of from 24 to 30 hr. On the other hand, during an acute reaction to radiation there is in- and trans-udation and vascular fibrinosis that are surely pathogenetic factors in the degenerative radiation injury of the spinal ganglia. It should be emphasized that the individual characteristics of any single ganglial cell, even of one and the same type, will control and vary its response to radiation. Severely damaged cells will be found adjacent to completely normal cells, and after extensive exposure there will be a widely varying spectrum of injury. (77 references.) (BBB)

38782 PRESERVATION OF VEGETABLES IN VENEZUELA BY IRRADIATION. J. Solanas and A. Darder (Instituto Venezolano de Investigaciones Cientificas, Caracas). Acta Cient. Venezolano, 14: 94-7(Aug. 1963). (In Spanish)

A pilot study was undertaken to investigate the feasibility of a radiation food processing program for Venezuela. The food products selected were potatoes, onions, and strawberries. Different groups of two kg each of potatoes received ^{60}Co γ radiation in doses of 1250, 5000, 10,000, and 20,000 rad 15 days after harvesting. Following this, control and irradiated tubers were stored in the dark at 10 to 22°C, at humidity of 60 to 95% with adequate natural aeration, and observed for eight months, the usual period of time between the winter and summer harvests. Onions received radiation doses of 2000, 2500, 3000, 3500, and 4000 rad, stored under the same conditions and observed for the same period of time. Strawberries were irradiated with 200,000 rad the day after harvesting and stored at 3°C and 90% humidity. They were examined at nine, 15, and 25 days post-irradiation. Results showed inhibition of sprouting in potatoes with 10,000-rad and higher doses. Weight loss was 7% at the 10,000 rad dose compared with 42% in controls. Sprouting was inhibited in onions with a dose of 3000 rad; weight loss was 15%. Strawberries were in good condition after 25 days, whereas unirradiated strawberries were inedible after nine days storage at 3°C. It is pointed out that with the doses used here possible undesirable effects, such as changes in flavor, aroma, texture, and nutritional value, which may occur at much higher doses, did not take place. (BBB)

38783 INFLUENCE OF X-IRRADIATION OF THE DOG KIDNEY ON ERYTHROPOIETIN PRODUCTION. James W. Fisher, B. L. Roh, and K. Shenep (Univ. of Tennessee, Memphis). Acta Haematol., 31: 90-102(1964).

Attempts were made to learn whether x irradiation of the kidney would modify the response to an erythropoietic stimulus. Therefore, studies were undertaken utilizing unilaterally nephrectomized dogs, to determine the influence of irradiation of the kidney on the response of erythropoietin secretion to a Co^{2+} stimulus. In addition, changes in creatinine and p-aminohippurate (PAH) clearances, blood urea nitrogen (BUN), hematocrit, blood pressure, baseline plasma erythropoietin levels, and body wt were studied in dogs after kidney irradiation. The right kidney was removed and the left kidney, exteriorized through a retroperitoneal incision, was exposed to 3600 R in a single exposure from a 240-kv x-ray unit. A marked suppression in the erythropoietic response to an injection of $CoCl_2$ was observed in the dogs 6 weeks following kidney irradiation. A gradual suppression in the excretory function of the kidney was also seen as indicated by lowered creatinine and PAH clearances at 3 and 6 weeks following kidney irradiation, and BUN values also progressively increased over the 6-week period after irradiation. It is concluded that x irradiation of the kidney in the unilaterally nephrectomized dog results in a significant suppression in erythropoietin production by the kidney, as well as a marked decrease in the excretory function of the kidney. The findings indicate that erythropoietin production by the kidney may be more sensitive to ionizing irradiation than the excretory function, which may be related to a more marked resistance of the renal tubules to radiation than the juxtaglomerular cells. Observations support the concept that the juxtaglomerular cells are the renal site of production of the erythropoietic hormone. It is postulated that the kidney is the source of a single erythropoietic hormone which is necessary for the maintenance of normal erythropoiesis and is also responsible for the polycythemias seen following stressful erythropoietic stimuli such as severe anemia, hypoxia, or Co. The inability to detect significant plasma levels of erythropoietin in normal humans is probably a reflection of the insensitivity of the assay methods. (TCO)

38784 HISTOCHEMICAL STUDIES OF THE TIBIAL EPIPHYSIS OF THE RAT AFTER X RAY AND COBALT RADIATION. H.-P. Putzke (Universitat, Rostock, Ger.). Acta Histochem., 15: 241-50(1963). (In German)

Two groups of 30 albino five week old rats were given 1000 R of 60-kV x radiation, and 1500 R of 1.2-Mev ^{60}Co radiation, respectively, in a single dose directed to the left hind extremity. The rest of the body was shielded by a Pb cage. The most outstanding histochemical effects of irradiation in the area of the epiphyseal cartilage of the tibia were the reduction of enzyme activities and changes in the ground substance. The results show that in the early stages after irradiation (two weeks) cell production, chondrocytes, and osteoblasts are markedly decreased, and enzyme concentrations are reduced. As a result, polymerization of the chondro-osteoid ground substance is impaired, with increase in acid mucopolysaccharides (MPS), and retardation of development. Osteoclasis is increased. In three or four weeks the cellular elements recover, with increased alkaline phosphatase activity. Polymerization of MPS accelerates with consolidation of the chondro-osteoid ground substance, but it results in a reduced area of development as compared to normal bone. (BBB)

38785 A CONTRIBUTION TO THE STUDY OF THE EFFECT OF IRRADIATION WITH SUBLETHAL DOSES OF X-RAYS ON THE REGENERATION OF HIALINE CARTILAGE. J. G. Cankovic, D. Mrsevic, S. Popovic, and O. Simonovic-Piletic (Inst. of Histology, Belgrade). Acta Med. Iugoslav., 16: No. 1, 34-43(1962). (In Croatian)

The Cankovic-Mrsevic experiment was repeated except that immediately prior to partial injury of the hyaline cartilage of the rib, the animals were exposed to a single whole-body x-ray dose of 800 R. The experiment was performed on 20 grown male rabbits of the same age, treated in the same way and killed after the same time intervals as in the above mentioned study. Comparing the findings obtained by the histological examination of slides obtained at the same time intervals, it was concluded that in the exposed animals not only that the reparatory-regenerative process is retarded, but there is a series of deviations from the reparatory-regenerative process under normal circumstances: that is to say that the reparatory-regenerative process under the conditions

of acute irradiation disease is similar in its main features to the reparatory-regenerative process under normal circumstances, only being slower; that the reparation with the hyaline cartilage is continuously suppressed and incomplete, or done by fibro-cartilaginous tissue, and the lines of regeneration are upset; that the reparation of the cartilaginous tissue at the end of regenerative process is also by osseous tissue, but compared to the reparation of the cartilaginous by the bony tissue under normal circumstances, occurs later and is irregular and incomplete until the end of the experiment; and finally that in the interspaces of the newly formed bone the bone marrow is almost completely absent. It is concluded that the perichondrium as the sceletogenous cambium retains its cambial properties after irradiation in regard to the formation of cartilage and in the final stage of bone, as in the non-irradiated animals, but the injurious effect of a single sublethal dose of x-rays (800 R) on its reparatory-regenerative properties is not time-limited and lasted throughout the experiment. (auth)

38786 A COMPARISON OF HIGH AIR PRESSURE TOLERANCE AND RADIATION RESISTANCE IN E. COLI B. Anna-Stina Malmborg (Karolinska Institutet, Stockholm). Acta Pathol. Microbiol. Scand., 60: 403-8(1964).

As a further investigation of primary reactions in the radioinactivation of biologic mechanisms, the radiosensitivity of two strains of Escherichia coli was compared. A study was designed to investigate whether a correlation exists between increased radiation resistance and resistance to high partial pressures of oxygen. Uv sensitivities of two strains of E. coli were compared, the uv-sensitive E. coli Bc and the uv-resistant mutant, E. coli Bc/r. Under various air pressures strain Bc and strain Bc/r showed no great differences in growth rate, i.e., no increased resistance to pressure could be observed with the mutant E. coli Bc/r compared with Bc. E. coli Bc/r seemed a little more resistant, but this was explained by the fact that this strain grew better than E. coli Bc under all the pressures used and in the controls. Although the fraction of bacteria surviving pressure treatment was higher for the uv-resistant than for the uv-sensitive strain, the difference was not of the same order of magnitude as the difference between the fractions of the same strains surviving uv treatment. The radiation-resistant strain reported was unable to repair the damage caused by high air pressure as efficiently as it repaired the damage caused by irradiation. In this respect it is almost as deficient as the radiation-sensitive strain. (OTS)

38787 THOROTRAST TUMORS: REPORT OF 3 CASES AND A MICRORADIOLOGICAL STUDY OF THE DEPOSITION OF THOROTRAST IN MAN. O. Hassler, K. Bostrom, and L. O. Dahlback (Univ. of Umea, Sweden). Acta Pathol. Microbiol. Scand., 61: 13-20(1964).

It is pointed out that it is desirable to report all cases of Thorotrast tumors observed because Thorotrast is one of the few radioactive materials with long half life that have been administered to human beings in comparatively large doses. This report concerns three new cases which had long induction periods. In all three cases the Thorotrast had probably been administered intra-arterially and the primary tumor was in the liver, which seems to be the most common primary location for tumors after intra-arterial injection of Thorotrast. The mean induction period was 23 years in the three moles. On the other hand, the dose of Thorotrast injected was lower in at least two of these cases than in most cases previously reported. The induction period for liver sarcomas is 12.6 ± 7.4 years and considerably longer (19.4 ± 4.0 years) for carcinomas. In the present material, the mean induction period for two cases of carcinoma was also longer (24 years) than that for the case of sarcoma (21 years). (TCO)

38788 STUDIES ON THE REACTIONS OF IRRADIATED ANIMALS (γ Co^{60}) TO ANESTHETIC DOSES OF ETHER. Jerzy Maruchin, Zenon Baltrukiewicz, and Slawomir Lipski. Acta Phys. Polon., 15: 427-38(May-June 1964). (In Polish)

The reactions of male rats of the Wistar race irradiated with ^{60}Co γ to anesthetic doses of ether were studied. The animals were subjected to whole-body irradiation with doses of 500, 700, 800, and 900 R. Anesthesia was induced in a flow chamber with constant concentration of ether fumes (6 to 7% vol) during 15 and 30 minutes after 24 hours and 7 days, and during 30 minutes only 7 days after the irradiation. Time of sleep, falling asleep, awakening and appearance of the tail reflex were recorded. Rats were found to exhibit increased sensitivity to ether 24 hours and 7 days after irradiation. Anesthetic sleep appeared sooner and lasted longer than in nonirradiated animals. Greater sensitivity to ether was observed after irradiation with doses of 500 and 700 R and during the first anesthesia on the 7th day after irradiation. (auth)

38789 EARLY RADIATION EFFECTS ON THE DIFFUSION OF MOLECULES IN THE ANIMAL BODY. A. Forssberg, G. Sundius, B. Tribukait, and Cl. Nyman (Karolinska Institutet, Stockholm and Karolinska Sjukhuset, Stockholm). Acta Radiol., 2: 161-8(June 1964).

A marked increase in the diffusion rate of molecules (^{131}I-albumin and ^{14}C-glycine) from the peritoneum into the blood circulation and the tissues was found to occur in whole-body roentgen irradiated mice. The effect was immediate and terminated some 15 to 20 minutes later. It was not evident following subcutaneous injection. The mechanism is discussed in relation to the immediate in vitro radiation effects on various membranes, and to changes in tonus of the gastrointestinal tract. (auth)

38790 BRAIN NECROSIS AFTER IRRADIATION OF THE HYPOPHYSIS IN CUSHING'S DISEASE. S. Almquist, S. Dahlgren, G. Notter, and L. Sundbom (Karolinska Sjukhuset, Stockholm and Karolinska Institutet, Stockholm). Acta Radiol., 2: 179-88(June 1964).

A case of Cushing's syndrome in which rotation roentgen irradiation of the hypophysis with 5,000 R over a period of 29 days led to encephalomalacia, hemorrhage into the ventricular system, and death is reported. The maximal radiation dose to the necrotic volume was estimated at 3,000 R, which is lower than the dose level for brain necrosis previously reported. (auth)

38791 RADIATION NEPHRITIS. R. W. Luxton and P. B. Kunkler (Christie Hospital, Manchester, Eng. and South Wales and Monmouthshire Radiotherapy Hospital, Cardiff, Wales). Acta Radiol., 2: 169-78(June 1964).

From the dose distribution calculated in the region of the kidneys, in a series of patients treated for seminoma testis, an estimate was made of the limits of renal tolerance. The clinical and pathological features of radiation nephritis, based on a long term review of 54 cases, are outlined. (auth)

38792 MYELOGENOUS LEUKEMIA AND ANEMIA OCCURRING IN THE DESCENDANTS OF ALBINO RATS ADMINISTERED 4-AMINOPTEROYLGLUTAMIC ACID OR RADIOSTRONTIUM (^{90}Sr); A CONTRIBUTION TO THE

ETIOLOGY OF LEUKEMIA. Takeshi Setsuda, Yoshiaki Iwahashi, Koshio Nishimura, and Yoshihide Inagaki (Kyoto Univ.). Acta Schol. Med., Univ. Kioto, 38: 248-61 (Dec. 1962).

It was shown that 4-aminopteroylglutamic acid (4-amino-PGA, an inhibitor of nucleic acid metabolism) and ^{90}Sr may be leukemogenic or teratogenic in Wistar rats. Myelogenous leukemia and anemia as well as kidney malformations occurred in the offspring of a hybrid strain of rats given 4-amino-PGA. Thus, of 9 Wistar rats injected intramuscularly with 4-amino-PGA continuously in a daily dose of 0.01 mg/kg body wt, myelogenous leukemia occurred in one of them about four months later. In three F1 generation descendants of hybrid rats of both sexes, given intramuscular injections of 4-amino-PGA in a daily dose of 0.05 to 0.01 mg/kg body wt, anemia was found and kidney malformation in one. Hybrid rats of both sexes and their descendants (F1) were given 4-amino-PGA in a daily dose of 0.01 mg/kg body wt. In two descendant rats (F2), obtained by inbred mating, splenomegaly with a marked myeloid metaplasia was found in one and anemia in another. Persistent hyperchromic anemia was found in 48 out of 56 descendant rats. Splenomegaly with a marked myeloid metaplasia was present in two out of 7 F2 rats and in one out of five F3 rats. Myeloid leukemia occurred in 8 descendant rats; three out of four F4 rats, one out of five F5 rats, two out of 14 F7 rats, one out of 9 F8 rats, and one out of two F9 rats. These leukemic rats succumbed to the disease from 180 to 553 days after birth, within 7 days after the discovery of leukemia. The alkaline phosphatase activity of peripheral mature neutrophils, as determined histochemically, was in general, lower in these descendant rats than in the control rats. Hematologic and histologic findings are also described for the offspring of Wistar rats treated with ^{90}Sr. Thus rats of four months of age were injected subcutaneously with ^{90}Sr in a dose of 0.5 to 1.0 $\mu C/g$ of body wt. A marked fluctuation of peripheral leucocyte count, especially of neutrophils, and delayed maturation of neutrophils in bone marrow were found in the descendant rats. Splenomegaly with myeloid metaplasia occurred in the F1 generation in one out of six siblings and myelogenous leukemia in another. Osteosarcoma occurred in the F2 generation in three out of 12 treated rats surviving over six months. These descendant rats were also injected intramuscularly with typhoid-paratyphoid vaccine in a dose of 0.4 ml/kg body wt, or sodium cobalt chlorophyllin in a dose of one mg/kg body wt. A less marked increase of peripheral neutrophils was found in these treated rats than in the control rats. In Wistar rats given ^{90}Sr in a daily dose of 0.2 to 0.8 $\mu C/g$ body wt and also in their offspring obtained by inbred matings, the alkaline phosphatase activity of peripheral mature neutrophils was found to be decreased. (BBB)

38793 IMMUNIZATION EXPERIMENTS WITH IRRADIATED LARVAE. I. STUDIES ON THE EFFECT OF X-RAYS ON EGGS AND LARVAE OF ASCARIDIA GALLI. I. Varga (Univ. of Veterinary Sciences, Budapest). Acta Vet. Acad. Sci. Hung., 14: 95-103(1964).

Under irradiation conditions used, are exposure of 80,000 R inhibited the development of the eggs of Ascaridia galli to the larval stage. The treatment of infectious eggs with 40,000 R practically inhibits the development of worms in the intestines, a range of 10,000 R inhibits the development of males. A linear relationship exists between the dose-range and the worm count decrease, as well as of the growth of worms, in the individual groups of birds, during the whole course of postembryonic development. No worms were excreted by any of the bird groups fed with treated eggs, during the 50-84 day periods of observation. Worms developed from treated infectious eggs were excreted earlier than normal worms in the control group. Conspicuous structural changes were seen in the sex organs of female worms, which developed from irradiated infectious eggs. A dose of 10,000-20,000 R appears suited for the attenuation of infective eggs of A. galli for the purpose of attempted immunization experiments. (OTS)

38794 ON THE EFFECT OF THE GAMMA EMITTER ^{60}Co AND THE BETA EMITTER ^{32}P ON SENSITIZATION AND THE COURSE OF ANAPHYLACTIC SHOCK IN THE DOG. W. A. Samzow (Institut fur Pathologische Physiologie des Baskirischen Medizinischen Institut, Ufa, Ger.). Allergie Asthma, 7: 32-8(Apr. 1961). (In German)

A study was conducted to clarify whether γ radiation from ^{60}Co exerted a densensitizing effect in sensitized dogs when whole-body radiation was administered at levels high enough to cause radiation sickness, whether animals were affected by γ radiation before injection of antigen, and whether irradiated animals would react to antigen injection by going into anaphylactic shock. The animals received doses of ^{60}Co γ radiation that ranged from 500 to 900 R, administered at various time intervals up to 23 days before or during sensitization to anaphylactic shock. There were some symptoms of radiation sickness in the dogs, but their physiological status resembled the symptoms very closely that appeared when the dogs were sensitized. Contrary to expectation, the radiation exposure reinforced the degree of shock. Of nine animals reinjected with a single dose of antigen, there were three cases of lethal shock, two of which died very shortly after the antigen injection. These early deaths are unusual in dogs, since death from anaphylactic shock rarely occurs within 2 hr. A single sensitized dog that had been injected with ^{32}P at a level of 0.8 $\mu C/kg$ was readily shocked. The degree of anaphylactic shock in this animal also seemed to be reinforced by the radioisotope, and the animal died 2 hr afterwards. (BBB)

38795 MICRONUCLEI AND RADIOSENSITIVITY IN THE ROOT MERISTEM OF VICIA FABA. F. A. L. Clowes (Oxford Univ.). Ann. Bot. (London), 28: 345-50(Apr. 1964).

Micronuclei appear when acentric fragments of chromosomes are left outside of the nuclear membrane at the end of mitosis. In radiation experiments their presence indicates that chromosomes have been broken and that the nucleus has undergone mitosis after the irradiation. Thus, percentages of cells with micronuclei in four regions of the root meristems of Vicia faba were used to measure sensitivity to acute x irradiation. There were two peaks in these percentages, occurring at about four and eight days after 360 rad and two and six days after 180 rad. Two peaks exist, probably because the radiation delays cells that were in G_1 much more than cells that were in G_2 in reaching the first postirradiation mitosis and consequently in displaying micronuclei in the following interphase. The relative heights of the two peaks therefore reflect the relative numbers of cells in G_1 and G_2 as well as the relative sensitivity of the two phases to chromosomal damage. The cells of the quiescent center are injured least by the radiation as they are mostly held at G_1. The meristem thus obeys the law of Bergonie and Tribondeau, but differs from that of Zea mays in that the meristematic cells of the cap initials and stele immediately adjacent to the quiescent center resemble the quiescent center much more closely than the stele 250 μ away in the numbers of micronuclei produced. This is consistent with the differences already known between the two species concerning rates of division in the

different regions of the meristem and the behavior of the meristem after severe radiation injury. It is suggested that there may be some mechanism that controls the relative lengths of G_1 and G_2 differently in the two plants. Although the quiescent center in Vicia is not so different in radiosensitivity from the immediately adjacent regions as it is in Zea, it is still the least sensitive part of the meristem at both the levels of radiation used here and, for this reason, its cells probably give rise to the regenerated meristem after severe radiation injury more often than any other region. (BBB)

38796 THE PATHOGENESIS OF FOCAL SOMATIC IRRADIATION INJURY. J. Chandler Smith (Western Reserve Univ., Cleveland). Am. J. Clin. Pathol., 41: 609-17(June 1964).

A review of changes in somatic tissues following irradiation shows that most of the changes occur after moderate doses rather than after extremely low or high doses. The two principal features of injury induced by moderate dose are identified as the latent period that precedes each lesion and the loss of cells that characterize each lesion. It is concluded that in the range of dose under consideration, the site of the critical injury is within the nucleus and the principal effect of the injury is an interruption of the mitotic process. Pathologic effects of radiation of various tissues are described. (OTS)

38797 PELVIC LYMPHNODECTOMY FOLLOWING RADIATION IN CERVICAL CARCINOMA. Daniel G. Morton, Leo D. Lagasse, J. G. Moore, Melville Jacobs, and George D. Amromin (Univ. of California, Los Angeles). Am. J. Obstet. Gynecol., 88: 932-43(Apr. 1, 1964)

Attempts were made to answer the question of whether current radiation techniques actually destroy metastatic deposits in the regional nodes in uterine cancer. A study was undertaken in 70 women with Stage I cancers of the cervix, in which every other patient was treated by primary transperitoneal lymphnodectomy, followed by full irradiation immediately upon recovery from the operation. Alternate patients were treated by radiation therapy first and by postradiation lymphnodectomy five to 16 weeks (average 8 weeks) later. Radiotherapy consisted of local Ra applications, and external ^{60}Co or ^{137}Cs therapy to the parametria and node-bearing areas, with doses of 8000 rad to point A, 4500 rad to point B, and 12,000 to 20,000 rad to the cervical canal. The results, in terms of incidence of node involvement support the thesis that modern radiation therapy can destroy cancer in the regional pelvic lymph nodes in a significant percentage of the cases. (OTS)

38798 EFFECTS OF IONIZING IRRADIATION AND CHEMOTHERAPEUTIC AGENTS ON HUMAN CHROMOSOMES. J. G. Moore, J. L. Van Campenhout, and W. W. Brandkamp (Univ. of California, Los Angeles). Am. J. Obstet. Gynecol., 88: 985-1000(Apr. 15, 1964).

Chromosome analyses in peripheral blood leukocytes were carried out on patients receiving irradiation therapy and several chemotherapeutic agents in an effort to compare the effects of these agents on chromosomes, and to determine whether the persistence of aberrations, as observed following irradiation therapy, also occurs in patients after they have received chemotherapy. The analyses were carried out in 55 subjects, including 10 control subjects, 10 untreated cancer patients, 10 irradiated cancer patients, 17 patients who had been receiving chemotherapy for their neoplasms, and 8 patients who had received both irradiation and chemotherapy. Cells were analyzed at 18, 96, and 144 hr following administration. Patients who had undergone irradiation therapy exhibited chromosomal aberrations after treatment that persisted for at least six yr, following termination of therapy. Patients who had undergone only chemotherapy for their cancers showed no aberrations similar to those noted following irradiation therapy. Age did not appear to be a factor governing the frequency of chromosomal abnormalities. If it is assumed that the life-span of circulating lymphocytes and monocytes is 3 to 100 days, the presence of chromosomal aberrations in irradiated patients beyond this time period implies a change in the blood-forming tissues which would continue to produce aberrant forms. Since many of the chemotherapeutic agents employed in this study are considered to be radiomimetic, the absence of fragmentation, breakage, and translocation similar to those found in the irradiated patients was considered surprising. It is possible that some of these agents require a higher concentration than can be attained clinically, or that there is a relatively brief period during which aberrations might be observed. The effect of irradiation on chromosomes was not limited to a specific chromosomal site, but was observed in a wide distribution of breakage in the aggregate of chromosomes. Since chemotherapeutic agents have a systemic effect, they probably are not capable of breaking specific chromosomes in a manner similar to that of ionizing irradiation. (BBB)

38799 CHROMOSOME PATTERNS IN IRRADIATED AND NONIRRADIATED PATIENTS WITH RHEUMATOID SPONDYLITIS. David S. Newcombe and Alan S. Cohen (Massachusetts Memorial Hospitals, Boston). Ann. Internal Med., 59: 859-64(Dec. 1963).

A comparison of the chromosomal aberrations in a group of irradiated and nonirradiated spondylitics was made. It was hoped that this would provide data on the effect of such irradiation on chromosome morphology and also supply information on the chromosomal constitution of patients with rheumatoid spondylitis. Two groups of patients were investigated, the first consisting of 12 males with rheumatoid (or classical ankylosing) spondylitis. The second smaller unirradiated group consisted of three female patients with spondylitis plus peripheral rheumatoid joint disease (that is, mixed disease). No constant autosomal or sex chromosomal abnormalities were noted in the karyotypes of the irradiated males or the female mixed spondylitics. The chromosome analyses indicated that the modal number of chromosomes obtained from peripheral blood cultures of male patients with pure rheumatoid spondylitis (including both the irradiated and nonirradiated subjects) and the females with mixed spinal and peripheral disease was 46. A comparison of the total modal and nonmodal numbers of chromosomes per cell among all the pure spondylitics, the irradiated group, and the nonirradiated group revealed no significant differences in their numerical distribution. Various types of chromosome and chromatid aberrations were observed, but when their distribution in cells of the irradiated group was compared to the cells of nonirradiated subjects, no significant differences were noted. Neither the Ph^1 chromosome seen in the chronic myelogenous leukemia nor the Ch^1 chromosome recently reported in a family with chronic lymphocytic leukemia was present in any of these cases. (OTS)

38800 CHANGES IN SEROMUCOIDS IN PATIENTS WITH MALIGNANT TUMORS OF THE GENITAL TRACT DURING PELVIC TELECOBALT THERAPY. A. Bompiani and F. Dambrosio (Università, Milan). Ann. Ostet. Ginecol., 84: 703-17(Sept. 1962). (In Italian)

Results are reported on the variations of seromucoid levels in 43 women, mostly with uterine cervical cancer, subjected to ^{60}Co γ irradiation. In 33 of these cases a total of 5000 to 6000 R was delivered in daily fractional doses of 150 to 200 R in the pelvic region. Seromucoid was isolated from the patients' serums, collected serially during the course of irradiation, by the method of Weimer and estimated both as tyrosine equivalents and on the basis of galactose-mannose content. After an initial rise followed by an early drop, both galactose-mannose and tyrosine levels were elevated, reaching a peak at ~2500 R. Thereafter both values declined to near-basal levels at ~3500-R accumulated doses, and then underwent slight rises toward the completion of therapy at 5500 to 6000 R. These late rises did not approach the magnitude of the peak at ~2500 R. To account for these findings it is suggested that the increased levels of seromucoid, which is in the α-globulin serum fraction, result from the depolymerization of the ground substance mucopolysaccharides in connective tissues by ionizing radiation, and their subsequent release into the circulation. (OTS)

38801 RADIOSTERILIZATION IN THE PHARMACEUTICAL INDUSTRY. P. Bonet-Maury. Ann. Pharm. Franc., 21: 151-60(Feb. 1963). (In French)

The bactericidal action of radiation is discussed and compared to that of heat and of antiseptics for the sterilization of pharmaceuticals. Statistical implications are reviewed. The sterilizing radiation dose is defined with regard to units, and various examples are chosen to demonstrate the radio-resistance of several kinds of microorganisms. Most bacteria are killed with a dose of 2.5 Mr, which corresponds to sterilization in the autoclave at 120°C for 20 min. Maximum sterilizing dose and effective sterilizing dose are defined. Chemical action of radiation is briefly mentioned. The effects of irradiation on pharmaceutical products, including instruments and containers, are outlined. No alteration was observed at 2 Mr for multivitamin preparations, antibiotics, hormones, and steroids, anticoagulants, or plasma. Preconditioning of vessels is emphasized. Applications of commercial importance in various countries and radiation sources for industrial uses are briefly reviewed. (BBB)

38802 CHANGES INDUCED IN THE BLADDER BY RADIATION THERAPY. E. Lasio and S. Zini (Ospedale Civile, Udine, Italy). Arch. Ital. Urol., 35: 361-403(Jan. 1963). (In Italian)

The literature relating to radiotherapy-induced bladder lesions, as caused by both intravesical and external irradiation, is reviewed, an extensive bibliography is provided, and 32 new cases of urinary bladder injury following electron, gamma, and x radiotherapy are presented. The lesions developing in each case are described in detail — clinically, cystoscopically, and histologically. Reduced bladder capacity was a final result of the sclerotic changes in many cases; this tended to be a late but progressive development. There were no apparent qualitative or quantitative differences in the lesions caused by the three types of radiation. (BBB)

38803 ^{60}Co IRRADIATION OF TWO ACTINOMYCIN-PRODUCING STREPTOMYCES STRAINS. Hansjoerg Schoenwaelder (Universität, Göttingen, Ger.). Arch. Mikrobiol., 39: 13-21(1961). (In German)

The γ irradiation of two strains of streptomyces gave a lethality of 90 to 97% at 100,000 r. Actinomycin-mixture-X-producing strain showed a smaller mutation rate than the actinomycin-mixture-C-producing strain. In radiomutants of one type produced from the strain Afro 2296 an increase in the actinomycin yield of almost 100% was obtained. Influences on the biosynthesis of actinomycin could not be determined. No new actinomycins differing in chromatographic R_f values or in qualitative amino acid composition from the starting actinomycin were found, nor did the ratios of the amounts of the individual actinomycins vary. The metabolism of the actinomycin-mixture-C-producing strain was influenced in that several mutants had the ability to reduce nitrate and to degrade starch. It was not possible to influence the ability of the cell to synthesize actinomycin through irradiation so that new biosynthetic actinomycins were produced. The biochemical decrease of the synthesis also was scarcely influenced by irradiation. Irradiation with ^{60}Co easily brought about complete cessation of actinomycin synthesis; in these cases, profound changes in the metabolism of the organism were introduced, which were nutritionally reversible in only one case. In the actinomycin-lacking mutants, there is apparently no damage to the synthesis of the amino acids occurring in actinomycin mixture C. (BBB)

38804 INCREASE OF THE ANTIBIOTIC FORMATION OF STRAINS OF STREPTOMYCES BY ROENTGEN IRRADIATION. Hans Schweizer (Biologische Anstalt, Deutsche Akademie der Landwirtschaftswissenschaften, Berlin). Arch. Mikrobiol., 39: 230-41(1961). (In German)

Large doses of x radiation (120,000 to 130,000 R) produced a lethality of 99.85 ± 0.1% in Streptomyces strains. It was possible to increase the antibiotic production of the strains by irradiation. During the irradiation of the mycelium, the spores of the culture were maintained in air. Because of the low survival rate it was possible to prepare single spore cultures by spreading a small number of spores on an agar plate. After three irradiation steps using Streptomyces strain 4/122, a polyene producer, single spore cultures could be selected with an antibiotic activity 17 times that of the original culture. Since the survival rate of Streptomyces spores is so low after irradiation, methods are described for preparation of single spore cultures even if the spores are joined in chains. Morphologic and physiologic changes by the irradiation are to be expected in this process. A decreased antibiotic production could be reactivated in various Streptomyces strains by irradiation. (BBB)

38805 MORPHOLOGICAL PECULIARITIES OF THE COURSE OF INFLUENZA IN CHRONIC RADIATION SICKNESS. V. P. Emaykina (Inst. of Infectious Diseases, Kiev). Arkh. Patol., 26: 54-60(Jan. 1964).

Morphological manifestations of viral influenza in the lungs of mice previously repeatedly irradiated with small x-ray doses are described in this report. Two hundred white mice were irradiated daily with 12 rads (total irradiation dose = 1212 rads) for 3 months 10 days. At end of irradiation, leucocytosis ranged between 300 and 6200. The original leucocytosis figures before irradiation was 10,150–13,600. Multiple small hemorrhages appeared at sites of developing baldness. One hundred fifty irradiated animals were infected on the 6th day following irradiation intranasally with type A virus of the PR^8 strain. Both the irradiated and infected group of animals as well as the control group were observed and periodically sacrificed during 12 months. In the histological examination, along with usual staining methods impregnation with silver according to Snesarev and staining according to Hart were used. The combination of previous irradiation with small doses for more than 3 months followed by influenza infec-

tion led to 15% of the cases developing large airless foci of lung tissue restructuring. Such foci in irradiated and influenza-infected mice developed 300% sooner than in the control group mice, infected with influenza but not irradiated. The foci of lung tissue rearrangement were areas in which the alveolar lumen was filled with proliferating epithelial cells of the underlying bronchi. In 1–2 months after influenza infection, the alveoli in the foci of bronchial and epithelial proliferation became cyst-like. The foci of lung tissue rearrangement were not reversible, therefore sclerosis of the fibrous stroma of the lungs developed in them (collagenization of argyrophilic fibers, scarifying of the alveolar walls, etc.), as well as peribronchial and perivascular sclerosis. The rise of foci of proliferating epithelial bronchial cells and sclerosis developing thereupon are closely related to changes in the acute period of influenza in irradiated animals (hemorrhaging, edema, suppurative bronchitis, and atelectasis). (auth)

38806 DNA AND IONIZING RADIATION. B. Cowlishaw (Univ. of Adelaide). At. Energy Australia, 7: No. 3, 28-31 (July 1964).

Radiation effects on DNA are discussed in terms of the biology and the physical chemistry of the irradiated molecule. Progress that may be expected in understanding both the biological importance of DNA irradiation and its importance in the field of polymer chemistry is briefly indicated. (H.M.G.)

38807 THE QUESTION OF RADIATION-INDUCED STIMULATION IN GYMNOSPERM SEEDLINGS. W. Herbst (Universität, Freiburg i. B.). Atompraxis, 10: 361-7(Aug. 1964). (In German)

The genus Pinus was found to be highly radiosensitive, and thus suitable for studies of stimulation phenomena following irradiation. The germinating rate, sprout growth, and root growth of Pinus silvestris and Pinus nigra austriaca were taken as criteria for stimulation following single, fractionated, and continuous irradiation of the seed and seedlings. A distinction was made between genuine stimulation, which was higher than that found in the controls, and relative stimulation of the recuperative type. Findings with various radiation doses were as follows: relative stimulation in dose ranges that were sufficient to cause marked damage to organs in the general organization of the plant; stimulation following doses more or less directly under the threshold of growth depression for the particular organ; and stimulation in the minimum-dose range. All the stimulation phenomena observed were ascribed to uncoupling processes. (auth)

38808 IRRADIATION INJURY TO THE GASTROINTESTINAL TRACT: CLINICAL FEATURES, MANAGEMENT, AND PATHOGENESIS. I. J. Wood, M. Ralston, and G. R. Kurrle (Royal Melbourne Hospital, Melbourne). Australasian Ann. Med., 12: 143-52(May 1963).

This report considers three cases of irradiation injury of the stomach and intestine following irradiation for cancer of the abdomen. In all the cases the primary lesion had been resected, and irradiation therapy was directed towards either the regional lymph glands or the pelvic tissues, in an attempt to cure proven or suspected metastatic growths in the pelvic glands and in the paraaortic chain of glands extending up to the central zone of the abdomen, or to prevent recurrence in the pelvis itself. Irradiation injury of abdominal organs other than the bowel did not occur, with the exception of the bladder in one case. It is concluded that in the patients studied, in addition to direct irradiation damage to the intestinal epithelium, the main factor causing the severe postirradiation damage was the injury to blood vessels and the subsequent depletion of blood supply. (TCO)

38809 INDIRECT TRANSFER OF RADIOGENIC LYMPHOMA. P. L. T. Ilbery and S. M. Winn (Univ. of Sydney). Australian J. Exptl. Biol. Med. Sci., 42: 133-48 (Feb. 1964).

The role of a subcellular agent in malignant transformation following irradiation in the C57BL low-leukemia mouse strain was investigated. In addition, a comparison was made of the karyotypic appearances in lymphoma induced in newborn mice by the inoculation of cell-free extract and that seen in the preleukemic phase of radiogenic lymphoma, radiogenic lymphoma itself, and spontaneous lymphoma. The dosage schedule for lymphoma induction was four 180 rad doses of ^{60}Co γ radiation at four-day intervals. The incidence of generalized lymphoma was 22% in mice surviving neonatal inoculation with cell-free extracts of radiation-induced lymphomas. The median time to lymphoma induction was 600 days, compared with a mean induction time of ~200 days in the controls submitted to the leukemogenic schedule of irradiation. Chromosome abnormalities, which were seen in high frequency in radiogenic lymphoma, were also observed in the lymphomas which followed inoculation with cell-free extracts. However, 16% of radiation-induced lymphomas showed no apparent departure from the normal mouse chromosome complement, a serious objection to the postulate of a causal relation between the observed changes and lymphoma induction. To explain the minority showing no apparent change, a small deletion could pass unnoticed in the mouse set. On the other hand, absence of a whole chromosome was seen in three mouse lymphomas of a total of 38 examined, so that deletion of a whole chromosome is compatible with viability and malignancy. The presence of an effect attributable to a subcellular agent yielding an incidence of disseminated lymphoma of 22% in the experiments using extracts from radiation-induced lymphomas accords with the theory of emergence of a latent virus following irradiation. Experimental support for the virus being an initiating agent is discussed. (BBB)

38810 EXPERIMENTAL STUDIES OF THE EFFECT OF ^{90}Sr RADIATION ON THE FORMATION OF ^{35}S-SULFATE IN CORNEAL TISSUES. W. Muenich. Ber. Deut. Ophthalmol. Ges., 64: 409-11(1961). (In German)

The effects of radiation from ^{90}Sr on the rate of ^{35}S incorporation were studied in the corneas of four groups of five guinea pigs each. The animals received 325, 500, 600, and 1000 R from a ^{90}Sr applicator 8 hr prior the parenteral administration of one mC of ^{35}S-sulfate. The animals were killed 80 hr after injection. A single dose of 325 or 500 R produced no significant changes in the percentages of total, inorganic, or ester sulfate incorporation of ^{35}S. Single doses of 600 and 1000 R were associated with statistically significant increases in the uptake of ^{35}S-sulfate in the total, and in the inorganic sulfate of the cornea. At 600 R these increases were from 10.3 and 11.1% greater than in the controls, and at 1000 R they were 16.8 and 30.6%. The incorporation of ^{35}S by the ester sulfate fraction was decreased by 9.7% in the 600-R group, and by 16.2% in the group that received 1000 R. The results showed that the permeability of corneal tissue for ^{35}S-sulfate was increased by the relatively small doses of 600 and 1000 R, and its rate of incorporation as ester sulfate into the mucopolysaccharides was reduced. The acid mucopolysaccharides and hyaluronic acid of the mesenchymal ground substance provide for a great deal of

swelling capacity, elasticity, and viscosity, thus providing mass and cement between cellular and filamentous portions of the tissue. Injury of the enzyme systems necessary for the synthesis and dissimilation of the mucopolysaccharides could be disadvantageous to the avascular cornea, where the entire transport of nutrients must take place through the ground substance. (BBB)

38811 NICOTINAMIDE ADENINE DINUCLEOTIDE PHOSPHATE-SPECIFIC DEHYDROGENASES IN RELATION TO LIPOGENESIS. S. V. Pande, R. Parvin Khan, and T. A. Venkitasubramanian (Univ. of Delhi). Biochim. Biophys. Acta, 84: 239-50(June 15, 1964).

The NADP-dependent malate dehydrogenase, combined hexose monophosphate shunt dehydrogenases, and isocitrate dehydrogenase activities were assayed in mitochondria-free fractions of liver obtained from normal fed, starving, starving but x-irradiated, and refed rats. Starvation for 48 hr decreased the first two enzyme activities to about half that of the normal liver, whereas refeeding for 48 hr with carbohydrate rich diets after starvation increased these enzyme activities over five times the normal liver value. In starving but x-irradiated (2400 R) rats the combined hexose monophosphate shunt dehydrogenase activity was similar to, and malate dehydrogenase (decarboxylating) activity was higher than, those of normal fed liver. There was no such marked effect of these experimental conditions on the isocitrate dehydrogenase activity which remained relatively unaltered. Compared with liver, in epididymal fat pads of normal rat the combined hexose monophosphate shunt dehydrogenases, malate dehydrogenase (decarboxylating) and malate dehydrogenase (L-malate:NAD-oxidoreductase, EC I.I.I.37) were considerably more active, whereas lactate dehydrogenase (L-lactate:NAD-oxidoreductase, EC I.I.I.27) and isocitrate dehydrogenase were less active. Thus in addition to the dehydrogenases of hexose monophosphate shunt, malate dehydrogenase (decarboxylating), but not isocitrate dehydrogenase, showed a close association with lipogenesis. Malate dehydrogenase (decarboxylating) is conceivably involved as a source of $NADPH_2$ formation. Experimental evidence is presented for the conversion of $NADH_2$ to $NADPH_2$ in preparations from liver and epididymal fat pads which involve malate dehydrogenase (decarboxylating) and malate dehydrogenase. (auth)

38812 ULTRAVIOLET SENSITIVITY AND THYMINE DIMERIZATION IN MUTANTS OF BACTERIOPHAGE T4. W. Sauerbier (Universität, Cologne). Biochim. Biophys. Acta, 87: 356-8(June 22, 1964).

Two mutations of bacteriophage T4 are described. The ultraviolet sensitivity and thymine dimerization characteristics of the mutants are discussed. (C.H.)

38813 DIFFERENTIAL MUTATION PRODUCTION BY THE DECAY OF INCORPORATED TRITIUM COMPOUNDS IN E. COLI. S. Person and R. C. Bockrath, Jr. (Pennsylvania State Univ., University Park). Biophys. J., 4: 355-65(Sept. 1964).

Differential mutation production by the decay of incorporated tritium compounds was studied in E. coli (WWU) using DNA-seeking precursors (^{3}H-thymidine), RNA-seeking precursors (^{3}H-uracil, ^{3}H-uridine), and protein-seeking precursors (^{3}H-histidine, ^{3}H-proline). In particular the reversion frequency of an arginine locus was determined. The reversion frequency is measured in units of revertants/surviving bacteria/^{3}H decay, and has an average value of 1.84×10^{-8} for ^{3}H-uridine and ^{3}H-uracil, 0.67×10^{-8} for ^{3}H-thymidine, and 0.28×10^{-8} for ^{3}H-proline and ^{3}H-histidine. Thus, the revertants are produced most effectively by ^{3}H decays when the label is introduced in the form of an RNA precursor. The macromolecular distribution of the label shows that 5 to 8 per cent of the ^{3}H-uridine or ^{3}H-uracil is incorporated into DNA. (auth)

38814 HISTOLOGIC RESEARCH ON THE RADIOSENSITIVITY OF LENS EPITHELIUM. L. Scullica (Università, Rome). Boll. Oculist., 41: 508-13(Aug. 1962). (In Italian)

Histologic and histochemical studies were conducted on the lens epithelium of rats of the Osborne-Mendel strain. The left eye of the animals was exposed to 1000 R of x rays and the animals were sacrificed at various subsequent intervals. Within one hr postirradiation regressive changes could be seen in the epithelial cells, which, became progressive, affecting more and more cells, particularly in the postequatorial zone. In the equatorial and pre-equatorial zones of lens epithelium, mitotic activity became completely inhibited two hr after irradiation followed by signs of nuclear degeneration. Regressive changes sometimes resulted in complete disorganization of the postequatorial zone, which showed confluent accellular areas. These changes were less marked in the other zones, the equatorial zone showing intermediate degree of injury. The central zone was relatively radioresistant. It is concluded that the differentiating and germinative zones of lens epithelium are the most radiosensitive. (BBB)

38815 THE MECHANISM OF PRODUCTION OF THE TERMINAL AND LETHAL ANEMIA IN CHRONICALLY IRRADIATED GUINEA PIGS. P. W. Edmondson and J. E. Morris (Medical Research Council Radiobiological Research Unit, Harwell, Berks, Eng.). Brit. J. Haematol., 9: 351-64(July 1963).

These investigations were made in an attempt to determine whether the absence of radiaion-induced anemia until shortly before death is evidence of normal erythropoiesis or whether a reduction in erythrocyte production is being masked by a compensatory reduction in blood volume. Efforts also were made to discover how important, quantitatively, is hemorrhage, and whether failure of platelet production or erythrocyte production is the basic lesion. By injection into the circulation of chronically irradiated guinea pigs, erythrocytes which had been labeled with ^{51}Cr, it was hoped that answers to these questions might be obtained. This would provide a means of determining the red-cell mass (RCM) while measurement of the ^{51}Cr in the excreta would give an estimate of the hemorrhage occurring in the irradiated gastrointestinal tract, the most important site of hemorrhage. The change in RCM over a time interval, considered in conjunction with the amount of hemorrhage, would provide an indication of the degree of erythrocyte production. The guinea pigs were chronically irradiated with 10-R daily doses until death or until the animals were sacrificed. The anemia resulting was sudden and late in onset, but significant hemorrhage never occurred until platelet counts had fallen to very low levels. The site of major hemorrhage was the gastrointestinal tract. The platelet count was a reliable indicator of the imminence of severe hemorrhage. The response of platelets was biphasic in that the platelet count falls initially, returns to near normal, and then falls steeply to thrombocytopenic levels. The plasma volume was not affected by irradiation and the circulating RCM did not begin to fall until hemorrhage had occurred. RCM was thus markedly correlated with the platelet count but only slightly with the duration of exposure and radiation dose. The rate of production of erythrocytes, derived from the change in

RCM and the amount of gastrointestinal hemorrhage over a 17-day experimental period, showed that after 1000- to 1400-R accumulated doses, erythrocyte production was at about half the rate in the controls and was not increased by hemorrhage as was normally the case. The primary cause of the anemia of chronic irradiation is, therefore, hemorrhage combined with an inability to increase the erythropoietic rate. An unexplained increased extravascular retention of ^{51}Cr within the spleen was also observed. (BBB)

38816 A CASE OF THORIUM-INDUCED CHOLANGIOMA. P. A. Ellis. Brit. J. Surg., 51: 74-6(Jan. 1964).

The case is described of a man aged 49 years who died of a carcinoma of intrahepatic bile-duct origin. Nearly 26 years before his death he had received an intracarotid injection of thorotrast while undergoing investigations which led to the successful removal of a meningioma. Deposits of thorium were demonstrated in his liver and spleen in life and confirmed at autopsy. (auth)

38817 CHANGE IN THE BODY TEMPERATURE OF WHITE MICE FOLLOWING TOTAL IRRADIATION WITH ROENTGEN RAYS. K. K. Poplavskii (Central Scientific-Research Inst. of Medical Radiology, Leningrad). Bull. Exptl. Biol. Med. (U.S.S.R.) (English Transl.), 55: 632-4 (June 1964). Translated from Byul. Eksperim. Biol. i Med., 55: 48-51(June 1963).

Total-body x irradiation caused significant disturbances of thermoregulation in albino mice. The character of these changes depends on three circumstances: body temperature prior to the irradiation, period of radiation injury development, and radiation dose. Thus, if the body temperature prior to the irradiation was 37.0 to 39.5°C it decreased during the first hours after the irradiation and this reduction was the greater the higher the radiation dose. A rise in body temperature was noted in mice whose body temperature was 34.5 to 37.0°C prior to this procedure. Irrespective of the character of body temperature variations during the first hours after the irradiation, temperature fell during the peak of radiation sickness. (auth)

38818 GENETIC EFFECTS OF IRRADIATION. J. McRae (Univ. of Sydney). Bull. Post-Graduate Comm. Med., Univ. Sydney, 19: 134-7(Aug. 1963).

Aspects of radioinduced genetic effects that are discussed include: an assessment of the risks involved, mechanism of induction of mutations, natural and man-made sources of radiation and their relative importance in human mutagenesis, nature of chromosome damage, and magnitude of hereditary injury. The possible mechanisms responsible for the lack of dependence of mutation rate on dose rate are discussed. It is suggested that some mutation events are capable of repair, and that a low dose rate permits this repair in some cell stages. The fact that the number of mutations can be altered by postirradiation treatment supports this concept. Nevertheless, it is concluded that all of the experiments indicate the effectiveness of radiation in producing hereditary damage even at the lowest doses and dose rates. Estimates of the doubling dose for man are given as 30 R for rapid dose rates and 100 R for low dose rates. (TCO)

38819 FUNCTIONING OF THE GALL BLADDER DURING ACUTE RADIATION SICKNESS. P. K. Klimov (Inst. of Physiology, Moscow). Byul. Eksperim. Biol. i Med., 7: No. 4, 46-9(Apr. 1964).

An experiment performed to determine the effect of radiation sickness on the influx of bile into the gall bladder and its subsequent thickening in dogs is described. The method of making roentgenograms after injection of an x-ray opaque substance into the blood is described, as well as the technique of administering a dose 500 R, of x rays to the animals. Series of roentgenograms of the process of bile influx in healthy and irradiated animals at stages up to 38 days after irradiation are given, and are analyzed in detail for both healthy and sick animals. It is concluded that radiation sickness caused irregularity of bile influx and dystonia and dyskinesis of the gall bladder and bile ducts. Regularity of bile influx was regained only at the end of the heating process. On the basis of preliminary experiments using adrenalin, carbocholine, chlorpromazine, atropine, it is suggested that disruption of the neurohumoral regulatory system of bile secretion may be an important factor in the disturbance of this mechanism. (auth)

38820 EFFECTS OF IONIZING RADIATION ON THE AGE SPECTRUM OF ERYTHROCYTES IN RABBIT PERIPHERAL BLOOD. A. D. Strzhizhovskii. Byul. Eksperim. Biol. i Med., No. 5, 52-5(1964).

The effect of γ-irradiation with ^{60}Co in 250 and 500 R doses on the hemoglobin content, erythrocyte count, and distribution spectrum by size were studied. A kinetic analysis was made of the data to estimate the rate of entrance of these cells into peripheral blood and their disintegration at various periods after irradiation. Irradiation caused the cells present in the peripheral blood at the time of exposure to disintegrate, the intensity of the process tending to vary with the age of the cells. There is a description of a paradoxical reaction of the erythropoietic control system to irradiation. (auth)

38821 TRANSLOCATIONS AND RECESSIVE LETHALS INDUCED IN ASPERGILLUS BY ULTRA-VIOLET LIGHT AND GAMMA-RAYS. Etta Kaefer and T. L. Chen (McGill Univ., Montreal). Can. J. Genet. Cytol., 6: 249-54(Sept. 1964).

A diploid strain of the fungus Aspergillus nidulans heterozygous for markers on all linkage groups was irradiated with ultraviolet light at doses which gave survival values of 1 to 5%. The genotype of 19 diploid survivors was analyzed by selecting a large number of haploids from each to detect induced translocations and lethals. No viable translocations were found, but recessive lethals showed a frequency of about 25% (5 cases). In addition, one case was found of a nucleus which contained either a translocation with recessive lethal effect (deficiency-translocation) or recessive lethals on two chromosomes. All controls were of parental genotype. From the comparison of these results with those reported in similar experiments using gamma rays it can be concluded that treatments of fungus chromosomes with ultraviolet light and ionizing radiations produce patterns of recessive lethal and translocation frequencies similar to those found in higher organisms. (auth)

38822 THE ARTIFICIAL INDUCTION OF ANEUPLOIDS IN AVENA. G. Y. Andrews and R. C. McGinnis (Univ. of Manitoba, Winnipeg). Can. J. Genet. Cytol., 6: 349-56 (Sept. 1964).

In order to produce a monosomic series in Avena sativa, a number of different methods for inducing aneuploids in this species was studied. Preflowering panicles of the varieties Garry and Rodney of A. sativa and of the tetraploid A. barbata and diploid A. strigosa were x-irradiated at 75, 150, 300, and 600 R to determine the most effective dose. In A. sativa, the frequency of aneuploids increased with the

level of irradiation. Although the 600 R treatment produced the most aneuploids, it also induced the greatest degree of chromosome damage and the monosomic frequency was not increased above that obtained from the 300 R dose. Most of the monosomics derived from the 300 R treatment were meiotically normal. Although the 150 R level produced fewer aneuploids than the higher doses, all were monosomics (except one trisomic) and the meiotic pairing was normal. It is concluded that the most effective treatment is from 150 to 300 R. Rodney appeared to be more sensitive than Garry to the effects of irradiation as a much higher relative frequency of aneuploids was obtained from the 300 and 600 R treatments; 13.3 and 23.1% respectively for Rodney as compared with 7.7 and 9.9% in Garry. Sonic vibration produced a low frequency of monosomics and appeared to have some promise. Pre-flowering treatment with the chemicals Myleran and 8-ethoxycaffeine by injection into the florets and into the stem was not successful in inducing aneuploidy. At present there are 126 monosomics and potential monosomics available for classification in Garry and 60 in Rodney. X-irradiation of A. barbata and A. strigosa panicles induced a number of aneuploids particularly in A. barbata where the frequency increased with the dose. Monosomic plants with 27 chromosomes were sterile but four with 27 + f set seed. Deficiencies in A. strigosa were either lethal or sterile. (auth)

38823 LONG-TERM EFFECTS OF THERAPEUTIC IRRADIATION UPON BONE MARROW. Marguerite P. Sykes, Herbert Savel, Florence C. H. Chu, G. Bonadonna, Joseph Farrow, and Hazel Mathis (Sloan-Kettering Inst. for Cancer Research, New York; Memorial Hospital for Cancer and Allied Diseases, New York; James Ewing Hospital, New York; and Cornell Univ., New York). Cancer, 17: 1144-8(Sept. 1964).

Aplastic sternal marrow was produced in 33 breast cancer patients treated with postoperative irradiation of 3,500 to 4,700 R. Bone marrow regeneration occurred in only 2 of the patients (6%), while the remaining 31 sternal marrows continued aplastic for a period of from 1 to 7 years post-therapy. (auth)

38824 VARIATIONS IN DRUG SUSCEPTIBILITY AMONG MOLONEY VIRUS-INDUCED TRANSPLANTABLE LEUKEMIAS. John P. Glynn, A. Raffaele Bianco, and Abraham Goldin (National Cancer Inst., Bethesda, Md.). Cancer Res., 24: 1303-7(Sept. 1964).

The variation in response to therapy of six transplantable virus-induced BALB/c leukemias was studied. Two of the neoplasms differed in their response to therapy with L-phenylalanine mustard (Melphalan), cyclophosphamide (Cytoxan), triethylene melamine, or x ray. Four additional tumors displayed variations in response to Cytoxan therapy when each was treated in its second transplant generation. The extent of variability in therapeutic response among the different transplantable leukemias was much greater than that observed for a given tumor line over a number of separate tests. The data indicate that the Moloney virus may induce a spectrum of transplantable leukemias in BALB/c mice and that the various induced tumors may be distinguished by differences in their responses to selected chemotherapeutic agents. (auth)

38825 CHROMOSOMIC MOSAIC PROBABLY RADIO-INDUCED IN UTERO. Jerome Lejeune, Roland Berger, Louise Archambault, Raymond Gorin, and Raymond Turpin (Ecole de Medecine, Paris). Compt. Rend., 259: 485-8 (July 15, 1964). (In French)

One, two, or three supernumary "minute" chromosomes were observed in the blood and cutaneous cells of an infant who drew attention because of a delay in mental development and physical development that was simultaneously dysmorphic and accelerated. An irradiation during the first month in utero was the probable cause of these lesions. (tr-auth)

38826 HEMATOLOGIC COMPLICATIONS OF IONIZING RADIATIONS ADMINISTERED IN THERAPEUTIC DOSES. C. Labram. Concours Med., 85: 849-53(Feb. 1963). (In French)

Hematologic disturbances following radiotherapy discussed are: leucopenia accompanied by neutropenia; a relative lymphocytosis without leucopenia; polycythemia; anemia; marrow aplasia or hypoplasia; and leukemias. In ankylosing spondylarthritis, leukemias seem to occur more frequently in those patients receiving x-ray treatment, and it is possible to establish a roughly linear relation between the frequency of leukemia and the dose received. Thus, 55 cases of leukemia following radiotherapy for ankylosing spondylarthritis have been reported, also 9 cases following a treatment with ^{131}I for various thyroid conditions. Radiophosphorus administered in the treatment of polycythemia has also been implicated in the causation of leukemias. It is concluded that ionizing radiations may be held responsible for an acute or chronic leukemia if the radiation dose administered is above 100 rad, and the time lapse for its appearance is from one to 15 years. Therefore, close hematologic surveillance is essential during radiotherapy, and it is recommended that a blood count should be made before each session of radiotherapy. (OTS)

38827 LEUKEMIA DUE TO IONIZING RADIATION. E. W. Doerffel (Regierungskrankenhaus, Berlin). Deut. Gesundheitsw., 16: 25-7(Jan. 5, 1961). (In German)

The relation of radiation dose and length of the latent period between exposure and appearance of leukemia in experimental animals is discussed. Increased frequency of human leukemia is considered in terms of clinical usage of radiation and exposure to atomic explosions. Hazards from x-ray and fluoroscopic examinations are compared, and it is concluded that the risk of exposure should be considered relative to the possible advantages obtained from any diagnostic purpose. (H.M.G.)

38828 RADIATION INJURY OF THE SPLEEN AFTER THOROTRAST INJECTION. Kurt Krueckemeyer (Pathologisches Institut des Staedtischen Krankenhauses, Berlin). Deut. Med. J., 13: 621-2(Oct. 20, 1962). (In German)

A 43-yr-old man was examined who had been injected with Thorotrast 22 yr previously for a brain study. On admission the patient complained of pain below the ribs on the left side, radiating toward the cardiac area. This was very noticeable after meals. The lungs and heart were normal. X-ray examination indicated deposition of metallic material in the spleen. This organ was also radioactive. The spleen was removed and was found to be markedly contracted, with a spotty fibrosis and a scarified, thickened capsule. Histologically, the trabeculae in the regions of the follicles and the cortical areas were infiltrated with deposited ThO_2. There were very massive ThO_2 granulomas in the pulp, with spotty necroses and evidence of very extensive recent hemorrhages. Tissues in the region of the deposited ThO_2 were extensively fibrosed. Below the massively thickened capsule ThO_2 crystals were marginally deposited in the reticular cells. The greatest effect of ThO_2 deposition was the spleen contraction, but there was no evidence of malignancy induced by the carcinogenic radiation from the ThO_2. Instead, the major effect was fibro-

sis. The damage from deposited ThO_2 increases progressively with time and is undoubtedly directly related to the concentration within the organ and the radiation intensity. Taking into account the long latency period and the relatively unlimited survival time, it seems definitely inadvisable to use ThO_2 in medicine, and thus to subject patients to the completely uncontrolled amounts of radiation damage produced by this substance. (BBB)

38829 RADIATION INJURIES OF THE SPINAL CORD. H. R. Schinz. Deut. Med. Wochschr., 89: 796-7(Apr. 17, 1964). (In German)

X radiation injuries to the spinal cord usually result from two situations. Nearly 50 cases have been reported as late injuries after radiation therapy of extraspinal and extramedullary malignant tumors. The spinal cord was partially in the radiation field. Another situation that can produce injury to the spinal marrow is when spinal tumors, either primary or metastatic, are irradiated. In these cases there is usually only some chance of cure if the tolerance dose for the spinal marrow is exceeded. This value amounts to 3500 R in 16 days or 4500 R in 40 days, with a range of variation of ~20%. Of 8 patients treated with 1100 to 5000 R three became free of tumor symptoms. The survival time amounted to 10 or 20 yr. In five other patients treated with 4400 to 12800 R late radiation injuries were observed. These were seen from four to 16 yr after radiation exposure. They were initiated by brief symptoms that were followed by paraplegia. The very high dosages administered were the result of repeated radiation series that were given when an initial clinical improvement was followed by a worsening of the patient's condition. An important conclusion can be drawn from these observations. Sometimes neurological disturbances recur or worsen after an interval of relative improvement brought about by radiation treatment. In these cases where a tumor may recur a probational or palliative radiation treatment series should not be initiated before thoughtful investigation of the possibility of late radiation injury is made. This should include spinal fluid examination, meylography, relaminectomy, etc. Where the case is doubtful, the radiologist should not advise additional irradiation. Apparently, the central nervous system of mammals and humans has little recuperative capacity as compared to skin and other organ systems. (BBB)

38830 ON THE CLINICAL DIFFERENTIAL DIAGNOSIS OF LATE SPINAL X-RAY INJURIES AND INTRAMEDULLARY TUMOR METASTASES. D. Seitz and H. Kalm (Universität, Hamburg). Deut. Z. Nervenheilk, 182: 155-75(1961). (In German)

Four cases where late spinal marrow injury followed x-radiation treatment for tumors in the region of the neck were observed. After spinal x-ray injury the neurological disturbances generally develop rather slowly over a period of months, while the tumor metastases produce a complete range of symptoms within only a few days. These rather relative differences depend on the pathological-anatomical localization and development of the processes. The hematogenic carcinomatous metastases localize in the spinal cord, and from there extend in all directions into the surrounding tissues. The circulatory disturbances that accompany this rapidly produce extensive transverse retractions. However, vascular changes are produced rather slowly by radiation. These late x-ray injuries of the spinal cord are observed after therapeutic irradiation of the neighboring soft tissues, especially the neck. As a rule the neurological disturbances appear from one to two yr after the initiation of the treatment. Usually a subchronic Brown-Sequard syndrome develops along with some neurological symptoms. After a rather long period of time this becomes transformed to a paralytic syndrome. Along with normal transport rates, the spinal fluid also has normal cell and protein concentrations. If they become clinically manifest at all, spinal cord tumor metastases generally produce a complete range of symptoms of paralysis syndrome within a few days or weeks. It is important to differentiate diagnostically between these two entities. When considering the differences between the clinical syndrome and of the disease process, it is important to note that, with the exception of thyroid carcinoma, primary tumors of the neck region apparently do not invade the spinal cord by a hematogenic pathway. (BBB)

38831 THE EFFECT OF CONTINUOUS IRRADIATION OF A GAMMA FIELD ON THE BIOMASS OF FRESHWATER ALGAL PERIPHYTON. E. A. Gileva, N. A. Timofeeva, and N. V. Timofeev-Resovskii. Dokl. Akad. Nauk SSSR, 156: 455-6(May 11, 1964). (In Russian)

Experiments were conducted to verify previously announced data on the stimulating effects of β and γ emitters on the development of fresh-water algae periphyton. The results of experiments with identical chemical mixtures did not confirm the published data. Therefore, a set of experiments was initiated in order to investigate the effects of continuous irradiation. The results are shown for 2-month irradiations at 0.5, 5.0, and 50 R per day. The results show that the periphyton mass, (dry weight) was 111% of the control for 0.5 R, 267% for 5 R, and 166% for 50 R. (R.V.J.)

38832 RADIOSENSITIVITY OF FEMALE GAMETES AT ANTE- AND POSTNATAL PERIODS IN THE RAT. E. A. Pozhidaev (Inst. of Experimental Medicine, Academy of Medical Sciences, USSR). Dokl. Akad. Nauk SSSR, 157: 684-7(July 21, 1964). (In Russian)

White Wistar rats were given a single whole-body, x-ray dose of 50 R. In the prenatal period the embryos were irradiated 10, 12, 13, 15, 17, and 19 days after conception. In the postnatal period the female rats were irradiated 7, 14, 20, 30, 40, 45, 50, 60, 75, and 90 days after birth. The irradiated female rats were mated with normal male rats, and the experimental results were evaluated on the 17 to 19th day of the first pregnancy. The results showed that on irradiating the females in the prenatal period, the embryo mortality in the first litter gradually increased from the 10th to 17th day after conception. The oocytes of the 19th day embryo were the least radiosensitive, and the mortality of embryos in these females approached that of the controls. In the postnatal period the radiosensitivity again increases and reaches a maximum in the 14-day females. At the end of four weeks of postnatal life, the mortality of embryos in the irradiated animals is about the same as that in the controls. The number of oocytes per ovary was also determined. The higher the mortality of embryos, the smaller the number of oocytes per ovary. (TTT)

38833 STUDY OF THE ^{131}I UPTAKE CURVES IN PATIENTS TREATED WITH COBALT THERAPY: CONTRIBUTION TO THE KNOWLEDGE OF THYROID FUNCTION IN THE IRRADIATED PATIENT. M. Piazza and G. E. Zarabini (Università, Bologna). Endocrinol. Sci. Costituzione, 27: 129-38(Dec. 1961). (In Italian)

The thyroid uptake of ^{131}I was measured before and after the treatment of 35 men for pulmonary or mediastinal cancer with ^{60}Co γ irradiation. A total dose of 4000 to 6000

rad was delivered over a 10 × 10 cm chest field, fractionated in 30 to 40 single, daily doses. The results were evaluated for two groups of patients: those with normal or low initial ^{131}I uptake values and those with elevated values before irradiation. In the first group, about half of the subjects showed an elevation of thyroid ^{131}I uptake after irradiation, whereas in the second group, the uptake levels tended to decrease after treatment. Basal metabolic rates tended to show the same variations as the ^{131}I uptake after treatment, indicating a reduction in thyroid function, particularly when it was initially increased, as a result of irradiation. In most irradiated subjects there was also a decrease in the urinary excretion of 17-ketosteroids, suggesting a decline in adrenocortical function after thoracic irradiation. All the patients tolerated the dose well, and even in patients given 6000 rad in a brief period (15 to 18 days) the results of thyroid function studies were the same as in patients given lower total doses in more protracted therapy. (BBB)

38834 INDUCTION OF MUTATIONS IN BARLEY AT VARIOUS STAGES OF DEVELOPMENT. Horst Gaul (Max-Planck-Institut fĭlr Zuchtungsforschung, Cologne). Euratom Bull., 3: No. 3, 10-11(Sept. 1964).

Barley spikes were irradiated with a ^{60}Co source at three different stages of development, before and after meiosis. Plants were then grown from the seeds which formed in the irradiated spikes. Mutations resulting in the loss of the ability to form chlorophyll occurred more frequently when the seed itself was irradiated than when irradiation took place at the stages before and after fertilization of the egg cell. An especially high proportion of poor (lower-yield) mutants was observed when irradiation was carried out after meiosis, but irradiation before meiosis produced approximately equal numbers of positive and negative mutants. (H.M.G.)

38835 EFFECTS OF IONIZING RADIATION ON AUSTRALORBIS GLABRATUS EGGS. Alina Perlowagora-Szumlewicz and Elmer G. Berry (Public Health Service, Washington, D. C.). Exptl. Parasitol., 15: 226-31(June 1964).

Experiments to test the action of x radiation on the development of Australorbis glabratus eggs are described. It was demonstrated that radiation effects on the development of the eggs range from delay in embryonic development to death of embryos. The sensitivity to acute radiation is dependent upon the stage of development of eggs at exposure. The period of maximum sensitivity coincides with the morula, blastula, and gastrula stages. The slow development of eggs exposed to sublethal radiation doses suggests that recovery from radiation damage may occur during the delayed period of embryonic differentiation. (auth)

38836 SURVIVAL, GROWTH, AND FECUNDITY OF AUSTRALORBIS GLABRATUS SNAILS DEVELOPED FROM EGGS EXPOSED TO IONIZING RADIATION. Alina Perlowagora-Szumlewicz (Public Health Service, Washington, D. C.). Exptl. Parasitol., 15: 232-41(June 1964).

Results are reported from experiments that indicate that irradiated Australorbis glabratus eggs may be capable of making adjustments that lessen the ill effects of radiation on further development and hatching of embryos. However, these experiments also show that the radiobiological lesions caused directly or soon after radiation may be revealed in the life of snails. Some of the radiation effects were time-limited and others were permanent. Impaired growth, increased mortalities, delayed maturation, and suppressed egg viability were temporarily affected processes confined to the life of juveniles and young adults, whereas suppressed fecundity, as indicated by the dramatically reduced numbers of viable eggs, persisted for the life of the individual. It was also demonstrated that the over-all strength of the radiation effect was sufficient to reduce the population derived from the irradiated eggs but did not prevent the re-establishment of a normal population by a subsequent generation. (auth)

38837 CHANGES IN THE RATE OF PROPAGATION OF ULTRASONIC VIBRATIONS IN THE BLOOD IN THE DYNAMICS OF RADIATION SICKNESS. I. R. Evdokimov (Bogomoletz Inst. of Physiology, Kiev). Fiziol. Zh., Akad. Nauk Ukr. RSR, 9: 251-5(1963). (In Ukrainian)

The study was conducted on dogs, acute radiation sickness being induced by x-irradiation in doses of 600 R. As a result of the investigations regular changes were found in the velocity of sound in the blood of the irradiated animals. The phase of these changes agrees with the periods of the course of acute radiation sickness. The rate of propagation of ultrasound in the blood was found to depend on the erythrocyte count and the percentage of hemoglobin. However, a complete quantitative correlation could not be established. (auth)

38838 SUBMICROSCOPIC AND MICROSCOPIC CHANGES IN THE PANCREAS DURING ACTION OF RADIOACTIVE STRONTIUM ON THE ORGANISM. O. A. Khomutovskii (Bogomoletz Inst. of Physiology, Kiev). Fiziol. Zh., Akad. Nauk Ukr. RSR, 10: 236-46(1964). (In Ukrainian)

Morphological methods of investigation were used to study the biological effect of ^{89}Sr and ^{90}Sr on the tissue of the pancreas (excretory division) of albino rats. It was found that ^{89}Sr and ^{90}Sr induce morphological changes in the excretory division of the pancreas differing in intensity and the period of their development. Strontium-89 induces perversion of the regeneration processes of injured tissues, while on introducing ^{90}Sr into the organism, degenerative, sclerotic and necrotic processes predominate. Submicroscopic changes in the structures of the excretory cells were observed during the first hour after administering ^{90}Sr. Densification of the nuclear shell sets in, the state of chromatin is altered, the arrangement of ribonucleoproteinic grains and ergastoplasmatic membranes is disturbed, the structure, form and number of mitochondria are altered. Complete normalization of the submicroscopic structures does not occur even in remote periods. In remote periods stable densification and thickening of the capillary basal membranes are observed, which hinders normalization of the regenerative processes of injured tissues. The difference of the biological effect of ^{89}Sr and ^{90}Sr is in the main due to differences in the absorption of energy in pancreatic tissues at the first stage of development of radiation sickness. (auth)

38839 CHANGES IN GLUTAMIC-OXALACETIC AND GLUTAMIC-PYRUVIC TRANSAMINASE AND ALDOLASE IN LIVER AND KIDNEY MITOCHONDRIA OF RATS SUBJECTED TO THE ACTION OF IONIZING RADIATIONS. L. Andri, L. Tominz, and M. Caprotti (Università, Pavia, Italy). Folia Med. (Naples), 45: 1248-53(Dec. 1962). (In Italian)

One lot of 13 white rats was subjected to total irradiation and sacrificed after 3 hr; a second lot of 14 was irradiated similarly (600 r) and sacrificed after 24 hr. Twelve animals were retained as controls. Mitochondrial suspensions were prepared from the livers and kidneys, maintained at

2–3°C, and used within 2 hr. Transaminase activity was determined by the method of Reitman and Frankel as modified by Candura, and aldolase activity by the method of Sibley and Lehninger. The following activities were determined for liver mitochondria glutamic-oxalacetic transaminase as μ mole substrate utilized per 100 mg protein. Sublethal doses of irradiation produce a variety of changes in activity, therefore, and these are compared with existing data in the literature. (BBB)

38840 SPORES OF MICROORGANISMS. IX. GRADUAL DEVELOPMENT OF THE RESISTANT STRUCTURE OF BACTERIAL ENDOSPORES. V. Vinter (Inst. of Microbiology, Czechoslovak Academy of Sciences, Prague). Folia Microbiol. (Prague), 7: 115-20(1962).

A study was made of the individual stages of the sporulation mechanism, with reference to synthesis of the most typical component of the spores, dipicolinic acid, and of the progressive development of thermoresistance and radioresistance during the sporulation phase. Radioresistance was investigated by x irradiation of Bacillus cereus, which was cultivated in liquid medium composed of 0.3% Amigen (tryptic casein hydrolysate), 0.1% glucose, and trace amounts of ions. In the first experiment the increase in the cystine content of the protein of sporulating cells, dipicolinic acid synthesis, incorporation of Ca, and development of resistance to irradiation and heat in the course of the sporulation process were studied. Calcium, in the form of $^{45}CaCl_2$, was added before inoculation, in a total concentration of 2×10^{-4}M or in radioactivity 0.62 μC/ml medium. The cells were irradiated with a dose of 120,000 R and parallel specimens were heated at 65°C for 15 min. The increase in the resistance of sporulating cells of B. cereus to x rays commenced during the prespore phase, when the proteins of the sporangium are being enriched with cystine. The possibility that the cystine structure contributes to the radioresistance of the spores is suggested. The relative increase in radioresistance occurs before the synthesis of dipicolinic acid and the incorporation of ^{45}Ca, but continues to increase gradually in the course of further development. The resistance of sporulating cells to higher temperatures develops progressively, according to the amount of dipicolinic acid synthesized. Thus this component seems to be connected mainly with the thermoprotective mechanism. Resistance to different higher temperatures develops in stages, with the amount synthesized. Since the Ca in the medium probably stimulates its synthesis and also influences the final amount of dipicolinic acid formed, the course of the development of thermoresistance is largely dependent on the Ca concentration in the medium. (BBB)

38841 AMYLOID LUNG RETRACTION WITH X RADIATION. Peter Spath (Universität, Geneva). Frankfurter Z. Pathol., 72: 309-19(1963). (In German)

A case is described of secondary generalized amyloidosis with involvement of the heart and both lungs, with marked retraction of the right lung, secondary to the administration of high dosage of x radiation given prior to radical surgery for carcinoma of the right breast. The patient had received a total of 18320 R in the course of 40 treatments two years previous to death. (C.H.)

38842 RADIATION LESIONS. Fernando Ortiz Monasterio, Alfonso Serrano Rebeil, Carlos Sanchez Mota, and Mario Becerra (Hospital General de Mexico, Mexico City). Gac. Med. Mex., 92: 1023-35(Dec. 1962). (In Spanish)

Lesions in cutaneous and subcutaneous tissues and produced by localized irradiation were studied in 139 patients. For each case the causes, latent period, incidence of malignancy, diagnostic problems, symptoms, and treatment of the lesions are presented. Owing to the great variety of radiotherapeutic indications, cases were divided into three categories. In the category of justified causes for irradiation were placed: malignant skin tumors, hemangiomas, and other malignant tumors. In the unjustified cause category were included: benign skin tumors, different types of dermatitis, hyperhidrosis, hypertricosis, and undiagnosed lesions. The technical error category included such causes as overdosage, inadequate protection, and equipment inadequacies. According to this division in 60% of cases there was a justifiable indication for irradiation. In 30% of cases the lesions appeared to be the result of some technical error of radiotherapy technique. Accuracy and speed in diagnosing radiolesions are discussed. It was concluded that a great number of the lesions in this series was due to ignorance of the physicians using x rays, inadequate precautions, or defects in equipment. The delayed diagnosis of radiation-induced lesions caused serious complications in many patients; the great frequency of this type of lesion is an indication of the need for radiation safety educational campaign among physicians and technical personnel, also the importance of limiting access to radiation equipment only to physicians who have specialized in radiology. (OTS)

38843 CARDIOVASCULAR SYSTEM CONDITION IN PERSONS DEALING WITH RADIOACTIVE PAINTS. L. G. Tsenterova. Gigiena i Sanit., No. 12, 42-6(Dec. 1963). (In Russian)

The health condition of painters, exposed to the chronic action of radioactive paints in the course of their work, was studied for a period of 9 years. In some persons under observation certain shifts due to the chronic effect of radiation developed. Examination revealed labile pulse, disturbed or inert oculocardiac reflex, a tendency towards gradual fall of arterial pressure, a decrease of electrocardiogram's amplitude, especially that of the T-wave, and a slight slowing-down of conductivity. In certain cases a vasopathogenic syndrome was present. The functional changes of the cardiovascular system may develop even in the first stage of the chronic action of the radioactive paints and may be detected by means of functional tests. The incidence and the extent of these disturbances are in a definite correlation with the length of the service record and the sanitary condition of work. (auth)

38844 THE IMPORTANCE OF THE QUALITY OF RADIATION FOR TEMPORARY X RAY EPILATION. P. Van Canaghem and A. Dunjic (Université, Louvain, Belg.). Hautarzt, 12: 370-3(Aug. 1961). (In German)

The assumption is made that hair follicles are relatively sensitive to relatively small variations in x-ray hardness is contrary to observations that have been made in other studies. Extreme differences in x-ray energy, and hence in the ionization layer affected, are required before modification of the biological reaction can be detected. These variations of radiation quality are much greater than those that were used in the studies made here in rats and by others in men. These studies in rats show that the epilation dose need not be increased if soft radiation rather than hard radiation is used, while at the same time the dose that reaches the deepest papillae is much less for soft radiation. This phenomenon can be reasonably explained if it is assumed that it is not the papillae situated at the deepest levels that determine the epilation threshold, but instead those that are the most radioresistant and lie closest to the surface. (BBB)

38845 SOME EFFECTS OF RADIATION ON STRUCTURAL AND BEHAVIORAL DEVELOPMENT. Samuel P. Hicks, Constance J. D'Amato, and John L. Falk (Univ. of Michigan, Ann Arbor). Intern. J. Neurol., 3: 535-48(1962). (TID-20090)

Developments in research on the effects of radiation on the developing nervous systems in man and animals are reviewed. Patterns of malformation induced by radiation, abnormalities of the cerebral cortex produced by radiation, neurophysiological studies of prenatally irradiated rats, behavioral studies of prenatally irradiated rats, and radiosensitivity and low dose radiation effects are discussed. (P.C.H.)

38846 ORGAN CHANGES AFTER INJECTIONS OF THORIUM DIOXIDE. K. Krueckmeyer (Pathologisches Institut des Staedtischen Krankenhauses, Berlin). Internist, 1: 471-4(Dec. 1960). (In German)

A 55-yr-old man who had been injected with ThO_2 16 yr previously died shortly after admission with diagnostic evidence of liver cirrhosis. Examination of the liver showed deposits of ThO_2 in the Kupffer cells, in the region of the inner third of the lobes, and especially immediately adjacent to the central vein. Deposits were found throughout the Glisson capsule. Wherever the ThO_2 was deposited, the cells were in various stages of necrosis and there were numerous foci of scarification which had replaced normal tissue. The entire organ was randomly cicatrized, but in each lobe the loci corresponded to points where the ThO_2 was deposited. The spleen structure was also extensively altered from normal. There was only isolated evidence of follicles, and these were located centrally. Massive ThO_2 deposits were present in the regions of the former follicles and in the margins of the lacunar tissue. The reticulum cells, trabeculae, and vessel walls were encircled by deposited ThO_2. Within the red pulp there was a lesser, but still definite deposition in the macrophages. In the region of these variously distributed ThO_2 deposits there was extensive fibrosis and necrosis, with complete structural disorganization. The broad areas of connective tissue formed had produced a complete lobular transformation of the organ. The capsule was thickened by fibrosis, and contained a broad band of ThO_2 deposited subcapsularly. Assay of the radioactivity of the ThO_2 indicated that its concentration in spleen was two or three times as much as in the liver. The spleen fibrosis was undoubtedly the result of the massive ThO_2 deposition, but it is uncertain whether its incorporation in liver caused the parenchymal damage. Presence of ThO_2 in the Kupffer cells and the Glisson capsule could have resulted from periportal cirrhosis. Often cirrhosis may resemble liver dystrophy, or dystrophia lenta, so that the ThO_2 may have only aggravated what was originally a genuine cirrhosis. (BBB)

38847 EFFECT OF X-IRRADIATION ON THE DEVELOPMENT OF IMMUNOGENIC UVEITIS. Arthur M. Silverstein (Armed Forces Inst. of Pathology, Washington, D. C.). Invest. Ophthamol., 2: 58-62(Feb. 1963).

The origin of the cells involved in the primary inflammatory response to intraocularly injected antigen was studied, taking advantage of the fact that x irradiation will depress or abolish the immune response to antigen. Into adult albino rabbits of the Hartley strain, 2 mg of crystalline egg albumen in saline was injected into the vitreous of the right eye, invariably inducing one week later spontaneous uveitis in the injected eye, the fellow eye remaining uninflamed. Twenty-four hours prior to such an intravitreal injection, a second group of rabbits was given a single exposure to 450 R of irradiation to the body, with the top of the head and eyes shielded. The spleen and all lymph nodes (including the preauricular ones) being irradiated. A third group received 450 R of x irradiation to the eyes, with the rest of the body shielded, and the same standard injection of egg albumen 24 hours after irradiation. The histologic picture of the inflammatory response in the irradiated eyes was in no way different from that seen in the controls, except that the immunogenic inflammatory response was superimposed upon tissue alterations due to the effect of the x rays. Different results were observed in the animals that had received, 24 hours prior to intravitreal injection of antigen, the x irradiation to the whole body with the eyes shielded. It was concluded that sensitization arises in the extraocular (lymphoid) tissues, and that circulating cells invade the eye in response to the attraction of residual antigen which, leaking only slowly from the depot in the vitreous, is able to persist in the eye during the period in which sensitization develops. Autochthonous ocular cells were observed only in the inoculated eye, and it was concluded that they were not related specifically to radiation but to an immunologic response. (OTS)

38848 THE EFFECTS OF X-RAY AND THERMAL NEUTRON IRRADIATION ON SOYBEANS. Yu-wei Cheng (Taiwan Agriculture Research Inst., Taipei, Formosa). J. Agr. Assoc. China (Taipei), No. 37, 23-33(1962). (In Chinese)

Effects of radiation treatment on soybeans in the first generation following seed treatment are reported. Seed of two soybean varieties were exposed to x rays and thermal neutrons. Both varieties were exposed to 10,000 and 15,000 R of x rays. With respect to thermal neutron treatment, the fluxes were 8.27×10^{12} and 1.34×10^{13} for Sankuo variety and 7.80×10^{12} and 1.27×10^{13} for Wakashima variety. Check plots raised from untreated seeds of each variety were planted simultaneously. The rate of seedling germination in treated lots was delayed as compared with check plots. However, there was a somewhat higher degree of seed germination in the thermal neutron treatments than in controls. During the growing period, many morphological abnormalities in plant characteristics of soybeans were observed in treated plots. Most of these marked phenotypic changes were chlorophyll deficiency, modified leaf shape, texture, leaflet number and changes in flower color from purple to white. Generally speaking, the thermal neutron treatments seemed to produced more of the qualitative variations. Both x ray and thermal neutron irradiations resulted a very high degree of sterility of soybeans. There were two types of sterility: plants with branchsterility and plants with pod-sterility. The x radiation gave the highest percentages of the two categories of sterile plants in both varieties. The flowering date and period of soybeans was visibly effected in treated plants, especially those x-ray treated. The heavier the doses, the slower and longer were the flowering date and period resulting. Sankuo variety had a longer flowering period than did Wakashima. The variation in plant height was visibly different in the two varieties tested. Both x and thermal neutron radiations caused more distinct effects on mature than on flowering soybeans. Radiation treatments also caused the distinct alterations in pod form, shape of seed, and color of hilum. From the results it was concluded that the x-ray and thermal neutron irradiations variously effected quantitative and qualitative variations of soybeans. The x-ray treatments induced more variation in quantitative characters than did the thermal neutron radiations. Yet somewhat higher rates of qualita-

tive changes were produced in thermal-neutron-treated soybeans than those treated with x rays. (H.M.G.)

38849 VIABILITY AND METABOLISM OF STAPHYLOCOCCUS AUREUS AFTER FREEZING, LYOPHILIZATION, AND IRRADIATION. T. H. Ahn, H. Nishihara, Charles M. Carpenter, and G. V. Taplin (Univ. of California, Los Angeles). J. Bacteriol., 88: 545-52(Sept. 1964).

Reproductive viability and oxidative activity on various substrates (alanine, glutamic acid, glucose, lactic acid) were studied in Staphylococcus aureus cells subjected to freezing and thawing, lyophilization, irradiation in suspension, irradiation in lyophilized state, and lyophilization and irradiation in the presence of various substrates. Freezing and thawing in dilute albumin solution had no effect on viable cell count and on lactic acid oxidation, but the oxidation rates of alanine, glutamic acid, and glucose were decreased. Lyophilization reduced the viable cell count to 25 to 30% of the initial value, and decreased the oxidation rates of glutamic acid and alanine proportionally, whereas decrease in glucose oxidation was less than proportional. The lactic acid oxidation rate was not affected by lyophilization. An irradiation dosage of about 40,000 R was required to reduce the viable count of cells irradiated in suspension by one $\log_{10}$ unit; lyophilized cells required 140,000 to 170,000 R. Cells irradiated in suspension with dosages sufficient to render them completely nonviable on culture continued to respire on lactic acid at about 60% the rate of nonirradiated cells, but the residual activities on the other substrates tested were less than 10 to 12%. Lyophilized cells irradiated with sufficient dosages for cultural nonviability retained 40 to 80% of the oxidative capacity of nonirradiated cells on the test substrates. Cells lyophilized and irradiated in the presence of albumin generally retained a greater portion of their oxidative activities compared with cells lyophilized and irradiated in buffer. Cells irradiated in the presence of various oxidizable substrates gave varying results, depending both on the substrate present during irradiation and the substrate added for the oxidative studies. (auth)

38850 FORENSIC NEUROPATHOLOGY. VII. CHANGES IN THE BRAIN INCIDENT TO EXTREME VARIATIONS IN TEMPERATURE, BAROMETRIC PRESSURE, ELECTRICAL CURRENT, AND X RADIATION. Cyril B. Courville (Los Angeles County Hospital, Los Angeles). J. Forensic Sci., 8: 82-96(Jan. 1963).

Previously published and new data are presented regarding the histopathologic effects of certain physical agents on the brain, with emphasis on their recognition for medicolegal purposes. A brief survey of the chronologic developments in the brain after exposure to radioactive materials is made. The effects of atomic radiation on the brains of casualties of the bombing of Hiroshima and Nagasaki are discussed. The result of exposure of fetal brain to x radiation is described by a case in which a pregnant woman was subjected to a course of radiation to produce therapeutic abortion. The typical clinical pattern of microcephalic idiocy seen here was an obvious effect of irradiation in utero. Results of overexposure of the mature brain to x radiation were seen in a 15-yr-old boy, who along with a younger brother, was given an overdosage of x radiation during treatment of ringworm of the scalp. The brain was later studied and characteristic changes were seen. It was concluded from this case that, while direct damage by x rays to brain may occur, in most instances regressive changes result from an interference with the local circulation. (OTS)

38851 EFFECTS OF ACTIVE IMMUNIZATION AND OF TOTAL-BODY X IRRADIATION UPON THE HUMORAL BACTERICIDAL SYSTEM OF THE GUINEA PIG AS MEASURED WITH STRAINS OF ENTERIC BACILLI. J. P. Steward, L. R. Collis, and R. J. Roantree (Stanford Univ., Palo Alto, Calif.). J. Immunol., 92: 616-25(Apr. 1964).

The effect of a midlethal (270 R) dose of total-body x irradiation upon the bactericidal activity of serum was determined by following titers of bactericidal antibody and bactericidal complement after irradiation, as well as the fate of serum-sensitive gram-negative bacilli added in vitro to serum collected following irradiation. The fate of these bacilli within intraperitoneal diffusion chambers implanted at various intervals following x irradiation was also determined; the incidence of bacteremia and the spectrum of bacteria responsible for this in the guinea pig were compared with information available for the mouse. Immunization of the guinea pigs did not result in significant increases in the number of bacteria killed within the diffusion chambers when a serum-sensitive mutant or a naturally serum-sensitive strain was used as test organisms. There was no evidence of a significant depression of complement-dependent humoral bactericidal activity after exposure of guinea pigs LD_{50} x irradiation. Contrary to some recent reports, no fall in the titer of naturally occurring bactericidins for an E. coli and for a Salmonella typhosa was found within 10 days after irradiation, nor was there a decrease of bactericidal complement. Infections in guinea pigs following irradiation were predominantly due to gram-positive organisms. This is in contrast to the mouse, in which it has been well established that a high percentage of postirradiation infections are due to gram-negative enteric bacilli. It is concluded that serum from an x irradiated animal is not a better medium for bacterial growth as compared with serum from the same animal before irradiation. (OTS)

38852 EFFECT OF INTERNAL IRRADIATION FROM COLLOIDAL CHROMIC PHOSPHATE (^{32}P) ON THE PRIMARY IMMUNE RESPONSE IN RABBITS. David S. Yohn and Samuel Saslaw (Ohio State Univ., Columbus). J. Immunol., 92: 762-71(May 1964).

Irradiation for 24 hr from 31, 60, 105, 120, or 488 μC of $Cr^{32}PO_4$ did not alter the immune responses of rabbits given three or four intravenous antigen injections over a 9- to 14-day period. However, when 14 days of internal irradiation from 520, 624, and 780 μC preceded a single immunizing injection, antibody responses to both antigens were significantly depressed. These effects included delayed appearance of antibody, decreased antibody synthesis rates, and lowered maximum antibody titers. When similar amounts of irradiation (488, 624, and 780 μC for 14 days) preceded a series of three antigenic stimuli given within 11 to 14 days, prolonged antibody induction periods were the only apparent evidences of radiation injury. These depressive effects paralleled those obtained in other experiments using external x and γ irradiation and internal β irradiation. The nearly complete reversal of immunologic impairment by additional antigen stimulus was attributed to compensatory hyperactivity of nonsplenic antibody synthesis sites. Splenic participation in the immune response of rabbits given 488 μC or more was probably nullified. The resultant immunologic impairment and its reversal with multiple antigen injections paralleled results obtained by other studies of surgically splenectomized rabbits. Possible applications of these immunologic-radiation relations in clinical use are suggested. The exact interval of immunologic impairment was not established.

Rabbits which received 650 μC of $Cr^{32}PO_4$ 36 days prior to three antigen injections, responded essentially normally, even though lymphopenic, during immunization. Lymphopenias were found to increase in intensity and duration with increased $Cr^{32}PO_4$ dose. It was estimated that minimums of 5 and 75% of the ^{32}P localized in the spleen and liver, respectively. Thus, during the 14 days rabbits given 488 to 780 μC $Cr^{32}PO_4$ received 7000 to 14,000 rep to their spleens and 150,000 to 300,000 rep to their livers. (BBB)

38853 THE EFFECT OF X-RAY ON THE ANTIGENICITY OF DONOR CELLS IN TRANSPLANTATION IMMUNITY. Charles F. McKhann (Karolinska Inst., Stockholm). J. Immunol., 92: 811-15(May 1964).

A study was made of the effect of graded doses of x rays, delivered in vitro to the immunizing cells, upon immunity against the normal genetically controlled transplantation antigens of mice. When strong histocompatibility factors associated with the H-2 locus were involved, irradiated cells induced immunity after as much as 12,800 R. When only the weaker factors derived from H-1 and H-3 were involved, similar numbers of cells failed to induce immunity after being subjected to much smaller doses of irradiation. They were effectively destroyed by as little as 400 R. The cells used to induce immunity were spleen cells and a methylcholanthrene-induced sarcoma. Possible biologic relation between strong and weak transplantation antigens are discussed and a reason for their different sensitivities to irradiation suggested. The inability of irradiated weakly antigenic lymphoid cells to induce immunity while similarly treated cells remained strongly antigenic with respect to their H-2 components suggests a basic difference between the actual antigenic structures controlled by the H-1 and H-3 loci, and those of H-2. Lymphoid cells are well known to be highly sensitive to x rays and are killed by doses as low as 400 R. Such treatment would immediately terminate the de novo synthesis of any antigen, strong or weak. The persistence of H-2 antigenicity in irradiated lymphoid cells indicates that the corresponding antigenic structures must be stable components, requiring no active metabolism on the part of the cell for their maintenance. The loss of H-1 and H-3 antigenicity in irradiated lymphoid cells indicates that these antigens are more labile components of the cells, a concept supported by the finding that these corresponding antigens are probably not associated with cell membranes and have not been recovered by the same extraction procedures that have been successful with H-2 antigens. The finding that weak transplantation antigens are sensitive to x rays is of clinical significance in that it may represent a practical way to eliminate part of the antigenic barrier between individuals. (BBB)

38854 DERMATITIS IN LEUKOPENIC GUINEA PIGS. Zenona W. J. Zagula, Henry C. Maguire, Jr., and Howard I. Maibach (Univ. of Pennsylvania, Philadelphia). J. Invest. Dermatol., 41: 405-11(Dec. 1963).

An acute allergic contact dermatitis reaction takes place in sensitized, severely leukopenic guinea pigs rendered leukopenic by whole-body x-ray exposure or cyclophosphamide treatment. 2,4-Dinitrochlorbenzene (DNCB) was used as allergic contactant and croton oil as a model primary irritant. Challenge sites were examined both clinically and histologically. Different groups of animals received 1000, 1200, or 2000 R, which doses are well above the guinea pig LD_{100}. Many of the animals sickened and died within 48 hours of irradiation while others survived as long as 8 days. As in other species, whole-body x-ray treatment induced a rapidly developing lymphopenia whereas concomitant granulocytopenia evolved more slowly. For instance, in a group of guinea pigs given 1200-R whole-body x rays, the peripheral white cell count declined from a control value of 9000 to 1000 in 3 days. Different dosage schedules of cyclophosphamide were used with the purpose of achieving greatest leukopenia with least morbidity and mortality. Irradiation-induced leukopenia slightly reduced the clinical response of croton oil dermatitis. Histologically, however, the dermatitis was dramatically suppressed and the degree of histological suppression correlated well with the degree of leukopenia. Also in cyclophosphamide-treated animals the croton oil skin reactions were less intense than those of controlled animals. The histological reaction of these leukopenic guinea pigs was markedly reduced both in terms of cellular infiltration and epidermal damage as against clinically comparable control animals. Similarly, in the cyclophosphamide-treated animals clinically the DNCB challenge was somewhat less intense than in comparable sensitized controls, and suppression of the histopathologic reaction was many times more marked and resembled in degree the cyclophosphamide suppression of the croton oil reaction. In x-irradiated animals, clinically the DNCB challenge responses were as depressed as their croton oil reactions; thus, the simultaneous DNCB reactions in the x-irradiated animals tended to be somewhat weaker than in the control group. However, whole-body irradiation severely inhibited expected histopathologic changes; there was a marked decrease or absence of cellular infiltrate in the dermis and virtually no evidence of epidermal damage. It is concluded that irradiation and cyclophosphamide produce an inhibition that is slight clinically but marked histopathologically in both allergic contact and primary irritant dermatitis. (BBB)

38855 DO X-RAYS CAUSE ONE- OR TWO-STRANDED MUTATIONAL EVENTS IN THE BACTERIAL CHROMOSOME? Bryn A. Bridges and R. J. Munson (Medical Research Council, Harwell, Berks, Eng.). J. Mol. Biol., 8: 768-70(May 1964).

In attempts to answer the question: does the mutational event involve one or both DNA strands of the chromosome, a study was made of revertants to prototrophy from tryptophan-requiring Escherichia coli WP2 using x-radiation doses low enough to permit the survival of most cells. Evidence was obtained as to whether the nuclei containing mutant genes give rise to progeny which are all mutants (indicating one mutable unit per nucleus) or half mutants and half parents (two mutable units per nucleus) and so on. When the bacteria were x irradiated under vigorous aeration at a dose rate of about 1000 rad/min at doses ranging from 500 to 3000 rad, the mutation rate per mutable unit per rad was $2.42 \pm 0.20 \times 10^{-11}$ and the mutation rate per nucleus per rad was $4.10 \pm 0.33 \times 10^{-11}$. From the ratio of these two values, 1.70 ± 0.20, it was concluded that there is an average of 1.7 units independently mutable by ionizing radiation per stainable nucleus in E. coli. Preliminary experiments in which cells each with a single resting nucleus were allowed to replicate in synchrony showed that the majority of cells were first scored as binucleate at a time very close to that at which the DNA in the culture was precisely doubled. (OTS)

38856 INHERITANCE OF FACTORS AFFECTING THE ABILITY OF BONE MARROW OF (C57BL X 101)F_2 MICE TO ESTABLISH PERMANENT GRAFTS IN IRRADIATED F_1 MICE. Raymond A. Popp (Oak Ridge National Lab., Tenn.). J. Natl. Cancer Inst., 33: 7-14(July 1964).

Marrow from (C57BL × 101)F_2 mice was injected intravenously into irradiated (C57BL × 101)F_1 recipients. Each donor was classified for H-2 serotype, hemoglobin, coat

color, and sex. Of the F_2 mice, 13.3 percent had marrow cells similar to those of the C57BL parent, judged by a reduced ability of the marrow to establish long-term grafts in irradiated F_1 mice. Thus, the factors associated with the regression of C57BL marrow grafts in F_1 recipients appear inheritable, but the number of factors and their biological nature are not known. The factors are not sex-linked nor linked with H-2, Hb, or A. The survivals of F_1 recipients of F_2 marrow of phenotypes H-2 b/k, H-2 b/b, and H-2 k/k were 94.8, 83.5, and 81.0 percent, respectively, which shows that differences in the survival of the recipients are correlated with H-2 incompatibility. However, differences in the survival of F_1 recipients of C57BL compared with 101 marrow (31.4 and 70.4%, respectively) cannot be ascribed solely to differences in the immunological competence of the H-2 b/b and H-2 k/k of C57BL and 101 marrow, respectively, since the survival of F_1 recipients of F_2 marrow of H-2 b/b and H-2 k/k genotypes is similar. (auth)

38857 HAIR COLOR CHANGES FOLLOWING RADIATION EPILATION. Leslie L. Alexander (State Univ. of New York, Brooklyn). J. Natl. Med. Assoc., 55: 546-8 (Nov. 1963).

The effects of radiation on the hair follicle are discussed and the case is reported of a man whose previously white hair reappeared as black hair after radiation-induced epilation of the scalp. Age and body region differences are presented as factors affecting hair radiosensitivity. Radiation effects on skin underlying epilated areas are also considered. (OTS)

38858 THE EFFECT OF RADIATION ON THE REGULATION OF THE RATE OF RESPIRATION OF MITOCHONDRIA IN LIVER. F. Y. Yang and K. C. Lee. K'o Hsueh T'ung Pao, No. 5, 441-3(1964). (In Chinese)

The regulation of the rate of respiration of mitochondria in liver, i.e., the ratio of the respiration rate after and before addition of DNP, was used as a sensitive indicator of the integrity of the mitochondria in liver. It has been found previously that the respiration rate of mitochondria in the liver of rats exposed to a whole-body x radiation dose of 700 rem tends to decrease, although the oxidative phosphorylation, P/O ratio remains unchanged. In the new series of experiments, the Mg and DNP activity of the mitochondria were compared after irradiation at a dose rate of 1015 rem/min. The mitochondria from the liver of the animals were placed in a 0.25M cane sugar solution at a p_H = 7.5, adjusting the concentration to 15 mg/ml of protein. Study of the regulation of the respiration rate and the P/O ratio revealed that after the irradiation without addition of DNP, the respiration rate increased with the total dose; with DNP added, the rate decreased with increasing total dose; the Mg activity increased with the total dose; and the DNP activity decreased with the total dose. The increase of the Mg activity was due to the increase of the rate of respiration without DNP. (TTT)

38859 STUDIES ON TOLERANCE OF MICE TO X-RAYS. Chung Chin Kim (Catholic Medical Coll., [Seoul, Korea]). Korean J. Zool., 6: No. 2, 11-15(Dec. 1963). (In Korean)

A total of 220 adult male mice (18 to 20 g) of the S.M. strain were divided into ten experimental and control groups. The total-body x-irradiation doses used were 50, 100, 200, 400, 600, 800, 1,000, 1,200, 1,400, and 1,600 R. The respiratory arrest (mortality) caused by each irradiation dose were observed for 30 days. Relationships between irradiation doses and survival time and percentage of response were examined. From this experiment, a formula was obtained to express the relationship among the three factors. LD_0, LD_{50}, and LD_{100} at each irradiation doses were determined within 30 days. The fit of formula was found to be moderately significant by chi-square test ($P > 0.05$). (auth)

38860 CAUSES OF GAMETE LETHALITY IN DROSOPHILA FOLLOWING FLIGHTS ON THE VOSTOK-3 AND VOSTOK-4 SATELLITES. G. P. Parfenov. Kosmich. Issled., 2: 335-40(1963).

No corresponding increase in the frequency of gamete lethals was observed in Drosophila following flights on the Vostok-3 and Vostok-4 satellites. The theory that vibration may cause dominant lethal mutations in males seemed to be supported by increased egg mortality following exposure of the fertilizing males to vibration in ground experiments. There are two possible explanations for the small but continuous and stable increase in egg mortality: vibration induces quasi-sterility (i.e., a temporary reduction in intensity of sexual activity of the males), or vibration or acceleration does have a deleterious effect on spermiogenesis. The fact that the frequency of egg mortality following exposure of females to space flight remained fairly constant for the whole period of the experiment and that the dose involved was small argues against radiation as the cause of dominant lethals in females. The most probable explanation is thermal shock: the experimental group was accidentally left for several days in the spaceship after landing, and it is entirely possible that the females were exposed to partially sterilizing temperatures during this time. Temporary curtailment of sexual activity in males and partial sterilization due to temperature effects in males and females account for the number of unfertilized eggs that were tallied in accordance with the experimental method as dominant lethal mutations. The term dominant lethal mutation must be regarded as having only a methodological significance. (TCO)

38861 STUDY OF THE DEGRADATION OF COLLAGEN BY γ-RADIATION FROM Co^{60}. [PART] II. A. Blazej, L. Cebecauer, and P. Bolvansky. Kozarstvi, 13: 323-5 (Nov. 1963). (In Slovak)

The destruction effect of ^{60}Co γ radiation on the collagen of animal hides was studied. A reduction of the shrinkage temperature of calfskin and pigskin was noted after exposure to 10^7 R doses; in cowhide even after a dose of 10^8 R. This indicated a lower stability of the younger tissues. Water extraction from the hides irradiated by 10^8 R yielded 2 fractions after division on a carboxyl methyl cellulose column and also on paper (using iso-, or n-butanol, acetic acid and water—1:2:0.8). Radiation destruction proceeded in the same way as thermal destruction, i.e., gelatin was formed. (OID)

38862 THE UROLOGICAL COMPLICATIONS IN THE THERAPY OF MALIGNANT TUMORS OF THE TRUE PELVIS. J. K. Ries. Krebsarzt, 16: 272-6(1961). (In German)

Radiation injuries of the ureters, bladder, and lymph nodes resulting from therapy of malignant pelvic tumors are discussed. (H.M.G.)

38863 MODIFICATION OF THE FOREIGN SPLEEN REACTION: AMELIORATION OF BLOOD AND TISSUE CHANGES. R. L. DeHart (Univ. of Tennessee, Memphis), G. E. Cosgrove, and A. C. Upton. Lab. Invest., 10: 872-82 (Sept.-Oct. 1961).

Mice injected with antigenically foreign spleen cells after whole-body irradiation develop a wasting, often lethal

disease within several weeks. In certain strains of mice, the reaction may be inhibited if the splenic or bone marrow cells are exposed in vitro to cells of recipient type before implantation. In this report the histologic and hematologic changes in animals undergoing the inhibited reaction were compared with those in animals undergoing the typical reaction. Ten- to 12-week-old (C57BL × 101)F_1 male mice were exposed to a single 600-R, sublethal dose of total-body x radiation. Within three hours of irradiation the mice received a suspension of C57BL spleen cells; a mixture of C57BL spleen cells and recipient-type (C57BL × 101)F_1 liver, or a suspension of isologous (C57BL × 101)F_1 spleen cells. Inactivation of donor spleen cells by exposing them to liver cells of the recipient type before their implantation resulted in considerable reduction of the severity of the blood and tissue changes of the foreign spleen reaction. The histologic findings, including reactive proliferation of lymphoid tissues, periportal infiltration in the liver, and secondary atrophy or necrosis of thymus and bone marrow, were lessened or abolished. In addition, there was improvement in hemopoietic regeneration, as manifested by more rapid return to normal of hematocrit and white blood cell and lymphocyte counts. The inactivation of donor spleen cells was ascribed to killing or alteration of the donor antibody-forming (presumably lymphoid) cells by pre-exposure to an excess of recipient antigen. On the basis of hematologic and histologic findings, there was no evidence that lymphoid cells were selectively killed by inactivation. Clarification of the mechanism will require identification of lymphoid and reticulum cells in each chimera as to their origin from donor or recipient, respectively, through the use of histologic and cytologic technics that permit localization of such cells in situ. The possibility that antibody-forming cells in the F_1 liver reacted in vitro against those of the parental graft cannot be excluded. (BBB)

38864 IMMUNOLOGICAL METHOD OF INCREASING SENSITIVITY OF PRIMARY SARCOMAS TO X RAYS. Marvin Bernstein (Upstate Medical Center, Syracuse, N. Y.). Lancet, 1: 1041(May 9, 1964).

The recently reported finding that immunization with tumor cells increases the radiosensitivity of primary tumors is discussed in view of related earlier findings. (TCO)

38865 EFFECTS OF DIAGNOSTIC IRRADIATION. P. R. J. Burch (Univ. of Leeds, Eng.). Lancet, 1: 1263-4 (June 8, 1963).

The recent findings of Stewart of a high frequency of previous x-ray examinations in myeloid and monocytic leukemia cases is evaluated in relation to the increased incidence of leukemia in Japanese atomic bombing survivors and irradiated ankylosing spondylitis patients. Data on the latent period for leukemia are presented that show that the interval between irradiation and the onset of leukemia is generally shorter in the heavily irradiated ankylosing-spondylitis series than in the less heavily irradiated survivors at Hiroshima and Nagasaki. It is pointed out that a difference of this kind is to be expected on the basis of animal experiments where large doses of radiation are associated with a relatively short latent period. Although the difference in latent period distribution between the ankylosing-spondylitis series and the nuclear bomb survivors is understandable, it is impossible to account for all the diagnostic radiographic evidence of Stewart in the same way. A special explanation is called for and the preleukemic unfitness hypothesis has the advantage of harmonizing a wide range of other epidemiological evidence with that discussed here. Wise's contention that the leukemic response in the ankylosing-spondylitis series is not well correlated with the mean dose to spinal marrow is considered in relation to the extreme complexity of the dose-response relation. For small doses of radiation to the adult the average dose to cells at risk (which for myeloid leukemia can probably be regarded as the average dose to active bone marrow) should be a good guide to the leukemogenic effect. The apparent ineffectiveness of digestive tract as compared with respiratory tract x rays in Stewart's data is difficult to account for on the radiogenic hypothesis. To decide whether any of the excess of diagnostic x rays in the leukemia series was due to an excess of illnesses or accidents in that group, it is important that the age and sex ratio of this series and any control group should be identical. A table compiled from earlier data reveals big discrepancies between the leukemia series and other groups. It is probable that the younger and more feminine composition of the leukemia series affects some of the conclusions regarding the relative frequency of illnesses and accidents. (BBB)

38866 EXPERIMENTAL DATA ON INTERNAL ELECTROLYTE SHIFT CONNECTED WITH RADIATION ILLNESS. Zoltán Zseboek and Gyoezoe Petrányi (I. sz. Sebészeti Klinika, Budapest). Magy. Radiol., 15: 164-70 (June 1963). (In Hungarian)

Experiments were conducted to determine the electrolyte shift, with particular attention to the Na content of intra- and extracellular space, which occurs in the gastrointestinal syndrome at the terminal phase of radiation illness. Rats were exposed to 1200 R whole-body x irradiation. The total exchangeable Na content, extracellular exchangeable Na content, and total and exchangeable Na contents of individual organs were determined by simultaneous injection of ^{24}Na and inulin at 72-hr postirradiation. Results showed that most of the organs did not significantly lose Na, the loss in muscle being offset by the gain in bone. Intracellular Na did not significantly contribute to the Na loss through the intestine. However, a significant loss (1.49 meq/100 g) was noted in extracellular space Na, which occurs through the digestive system and is not all excreted, causing the electrolyte shift. It is pointed out that damage to the intestinal mucosa is not the only cause of the electrolyte shift, but that injury to the nervous system and metabolic processes as a result of whole-body irradiation should be considered also. (TCO)

38867 NEUTRAL 17-KETOSTEROIDS AND SEXUAL CYCLES IN NORMAL MONKEYS AND AT REMOTE PERIODS AFTER IRRADIATION. L. V. Alekseeva. Materialy Nauch. Konf. Inst. Eksperim. Patol. i Terapii, Akad. Med. Nauk SSSR, Sukhumi, Sb., 3-4(1963).

The functional changes in the condition of the adrenal glands (secretion of 17-Ketosteroids) in connection with the sex cycles in female monkeys who had been exposed to irradiation in doses of 400 to 700 R several years prior to the experiment were observed. On the basis of the tests it was established that the secretion of 17-Ketosteroids during sex cycles in nonirradiated monkeys and in irradiated monkeys did not proceed equally. There was an absence of variation of the cyclical phases of the excretion of 17-ketosteroids in the irradiated females. This fact permits the author to assume that at least some of the cycles of these animals proceed in an anovulatory form, a finding which had been corroborated by other tests. (auth)

38868 DAMAGE TO THE FETUS MATURING IN UTERO BY IONIZING RADIATION. J. Trautmann and C. Kraft (Roentgeninstitut und Strahlentherapeutische Klinik am Staedtischen Krankenhaus, Moabit-Berlin, Ger.). Med. Klin. (Munich), 56: 465-71(Mar. 26, 1961). (In German)

The dependence of fetal radiation injury on age and radiation dose is discussed. It is stressed that experimental and clinical irradiation should be avoided during pregnancy since the degree of fetal injury is directly related to radioinduced maternal injury. The difficulty of differentiating between fetal injury induced by radiation and fetal injury arising from other factors is considered. (H.M.G.)

38869 COMPARATIVE STUDY OF THE MICROSCOPIC AND ULTRAMICROSCOPIC STRUCTURE OF IRRADIATED CELLS OF THE YEAST SACCHAROMYCES VINI AND RHODOTURULA GLUTINIS. M. N. Meysel, G. A. Medvedeva, V. I. Biryuzova, and T. M. Volkova (Inst. of Microbiology, Academy of Sciences, USSR and Inst. of Radiation and Physicochemical Biology, Academy of Sciences, USSR). Mikrobiologiya, 33: 270-7(Mar.-Apr. 1964).

The study revealed the principal peculiarities of protoplast organization of the two very different species. These peculiarities were correlated with the peculiar metabolism of the two species. The obligate aerobic Rhodoturula glutinis is considerably more radiosensitive than Saccharomyces vini, which is a good fermenting agent. Radiation doses which do not cause rapid death of the yeast cells during irradiation itself cause no acute structural and morphological changes in them. Only doses which severely hamper fundamental metabolic processes cause microscopic and ultramicroscopic damage. Here the initial disorders are at the molecular level and these are magnified as metabolism proceeds so as to be visible first under the electron and then the optical microscope. The most important damage observed was to mitochondria. In the S. vini cell several areas became denser and in many cases with R. glutinis. (auth)

38870 ERYTHROPOIESIS, A MODEL FOR THE STUDY OF FACTORS AFFECTING CELL PROLIFERATION IN THE MAMMAL. G. Hodgson and I. Eskuche (Universidad de Chile, Santiago). Natl. Cancer Inst. Monograph, No. 14, 169-84(1964).

The advantages of erythropoiesis as a model system for the study of factors affecting cell proliferation are discussed. Experimental results of studies carried out with this system are presented. The dose-response curve to erythropoietin in irradiated plethoric mice given injections of bone marrow is different from that of nonirradiated plethoric mice. The maximum effect depends on marrow dose, and the dose producing half maximum effect is 6 times greater than in nonirradiated recipients. Assays of radiosensitivity of erythropoietically competent stem cells have been carried out by two methods: In one the ability of the irradiated cells to repopulate erythropoiesis in a lethally irradiated host is evaluated; in the other the capacity of the animals' own surviving stem cells to repopulate is measured. Fractionation of γ-ray dose had a marked effect on recovery of erythropoietic function after irradiation. Recovery was maximum when doses were separated by a 5-hour interval. Survival curves for erythropoietic function after γ-ray doses varied with the state of erythropoiesis at the moment of irradiation: the greater the level of erythropoiesis, the larger the shoulders on the curves. Recovery of erythropoietic function after irradiation in animals with high levels of endogenous erythropoietin showed a biphasic response, with an early abortive rise at day 6 and final recovery at day 18 at which time erythropoietic function was recovered in irradiated animals with low endogenous levels of erythropoietin. (auth)

38871 THE EFFECT OF SMALL DOSES OF EXTERNAL BETA-IRRADIATION ON GLUTATHIONE AND ASCORBIC ACID CHANGES IN THE SKIN AND BLOOD OF EXPERIMENTAL ANIMALS. T. A. Glavinskaya and V. S. Sakharova. Nauchn. Zap. Gor'kovsk. Nauchn.-Issled. Inst. Dermatol. i Venerol., 23: 25-30(1962).

No reliable change in total glutathione was observed in the skin of guinea pigs two hours after external beta-irradiation in a dosage equivalent to that used in dermatology (20 R), but there was an appreciable rise in SH-glutathione content: a 40% increase on the irradiated side and 23% on the nonirradiated side. No deviations from normal levels were observed in total glutathione and SH-glutathione content three days later; SS-glutathione was 30% lower on the irradiated side and 20% lower on the intact side. By the fourteenth day, the glutathione content was normal. Ascorbic acid content and ability to reduce dehydroascorbic acid were diminished two hours after irradiation by 37 and 18%, respectively, on the irradiated and non-irradiated sides. Three days later the ascorbic acid content returned to normal. No appreciable changes in glutathione and ascorbic acid concentration in the blood under the effect of irradiation were observed. It is stated that in connection with the phasic nature of changes in oxidation-reduction processes in the skin, it is advisable not to repeat beta-irradiation in clinical practice at less than 5 to 7 day intervals. (auth)

38872 DYNAMICS OF QUANTITATIVE MANGANESE CONTENT IN TISSUES AND ORGANS OF ANIMALS WITH RADIATION SICKNESS. G. O. Babenko. Nauk. Zap. Straislavs'k. Med. Inst., 4: 93-102(1961).

Radiation sickness was produced in dogs, rabbits, and guinea pigs by total x-irradiation as well as intravenous injection of ^{32}P. Manganese concentration after irradiation was decreased in the liver and lungs of dogs and in the muscles of rabbits and guinea pigs; in the lungs of guinea pigs and muscles of dogs it was increased; in the liver and lungs of rabbits and in the liver of guinea pigs it remained at the same level as in the control group. Manganese deficit produced within the first post-irradiation hrs usually persisted until the animals' death. (auth)

38873 RADIATION, CHROMOSOMES, AND VIRUSES IN THE ETIOLOGY OF LEUKEMIA: EVIDENCE FROM EPIDEMIOLOGIC RESEARCH. Robert W. Miller (National Cancer Inst., Bethesda, Md.). New Engl. J. Med., 271: 30-6(July 2, 1964).

Epidemiologic research which has contributed evidence implicating ionizing radiation and chromosomal aberrations in the genesis of leukemia is reviewed. This survey of laboratory and isolated clinical observations, as well as a variety of epidemiologic studies, shows that ionizing radiation can induce leukemia in man. Still open to question are the leukemogenic effects of relatively low radiation doses. (TCO)

38874 STUDIES ON GLUTATHIONE IN EXPERIMENTAL RADIATION CATARACTS. Katsuhiko Otsuka (Kyoto Univ.). Nippon Ganka Gakkai Zasshi, 65: 1005-30 (July 10, 1961). (In Japanese)

Rabbits were injected with glutathione, L-cysteine, aminoethylisothiuronium (AET), and mercaptoethylamine (MEA). The doses via the subconjunctival route were 30,

30, 10, and 10 mg, respectively. The doses via the intravenous route were 1.0, 2.0, 0.30, and 0.30 g, respectively. Physiologic salt solution was injected into controls. After the injections, eyes were x irradiated with a single dose of 1500 R. The amount of reduced glutathione in the crystalline lens was determined after 48 hr, and in aqueous humor, it was determined after one hr and after 48 hr. Clinical features were also investigated. In the crystalline lens, reduced glutathione showed a significant increase after intravenous injection of 2.0 g of L-cysteine and 2.0 g of glutathione. In aqueous humor, reduced glutathione increased after 48 hr in all cases. In rabbits that received an intravenous injection of 2.0 g of L-cysteine or 2.0 g of glutathione or subconjunctival injection of 10 mg of MEA, a significant increase was observed, compared with the controls which received injection of physiologic salt solution only. As to clinical features, intravenous administration of protectants generally showed remarkable effects. The appearance of opacity of the lens was delayed in rabbits which received intravenous injections of 2.0 g of L-cysteine or 2.0 g of glutathione. The opacity was not progressive and the degree of clouding was slight. It is concluded that in the lens and aqueous humor, fluctuation of reduced glutathione at the initial stage postirradiation has a close association with the occurrence of x-ray-induced cataract. (BBB)

38875 THE EFFECTS OF ADENINE ON THE LEUCOPENIA AFTER X IRRADIATION. (1st REPORT). Tomotada Owan (Kumamoto Univ., Japan). Nippon Igaku Hoshasen Gakkai Zasshi, 21: 1170-8(Mar. 25, 1962). (In Japanese)

A study was made of the effects of adenine on the leucopenia occurring after x irradiation, i.e., the changes in peripheral blood cell counts of malignant tumor patients, especially of leucocyte counts. The adenine-injected group received a daily dose of 20 to 60 mg, and a control group (noninjected) was followed for four weeks during radiation therapy. The adenine-injected group was divided into Group A (8 cases), in which the prophylactic effect was investigated by its administration to each patient after the first irradiation, and Group B (4 cases), in which the therapeutic effect was evaluated by daily administrations after manifestation of the leucopenia caused by irradiation. The results in Group A indicated that the prophylactic effect of adenine, regarding the leucopenia occurring after irradiation, is considerable. In Group A, recovery from the leucopenia was accelerated compared with the controls and a gradual increase of leucocyte counts was induced in some patients despite continued irradiation. Absolute numbers of neutrophils increased gradually, and those of lymphocytes decreased, however less than in the controls. The therapeutic effect of adenine on the leucopenia was even more distinct. In Group B, leucocyte counts increased rapidly, rising to the previous normal value within three weeks after administration of adenine. Recovery from leucopenia, as described above, resulted from increases of both neutrophil and lymphocyte counts, and the rate of increase was higher in lymphocytes than in neutrophils. Successful results were obtained in all cases administered daily doses of over 40 mg, while a daily dose of 20 mg was not always enough to improve the leucopenia. No side-effects were observed that could be attributed to adenine. (BBB)

38876 EFFECTS OF L-TRIIODOTHYRONINE ON GROWTH AND RADIOSENSITIVITY OF TUMORS. REPORT I. Takayoshi Shima (Tottori Univ., Yonago, Japan). Nippon Igaku Hoshasen Gakkai Zasshi, 22: 1204-10(Feb. 25, 1963). (In Japanese)

The effects of L-triiodothyronine (T_3) on growth and radiosensitivity of several types of tumors were studied in mice and rabbits. Administration of T_3 produced an increase in radiosensitivity of rabbit skin, and accelerated the healing of skin lesions induced by irradiation. The mitotic rate of Ehrlich ascites carcinoma cells in mice was increased after T_3 injection at all dose levels between 2.5 and 10 μg/mouse. The growth rate of transplanted mammary tumors in C_3H mice was increased by daily injections of 2 μg T_3, and a similar result was obtained with Ehrlich subcutaneous tumors in strain dd mice. The transplantability of mammary tumors in C_3H mice was decreased by daily injections of 2 μg T_3 for 7 days, and a similar result was obtained with Ehrlich tumors in dd mice. The reduction of mitotic rate of Ehrlich ascites carcinoma cells in mice, caused by x irradiation, was increased and prolonged by daily injections of 5 μg T_3 from two days before irradiation. Investigation of the combined effects of T_3 and x rays on the growth of mammary tumor and Ehrlich tumor, transplanted subcutaneously in mice, showed a similar synergistic effect as observed earlier. These results suggest that a moderate dose of T_3 may be useful as a radiosensitizer in radiation therapy of malignant tumor, but this drug has to be applied carefully, because the growth of unirradiated tumors is increased by it. T_3 accelerates the healing of radiation skin damage, and this drug therefore may aid against recurrence and metastasis of tumors to some degree. (BBB)

38877 EFFECTS OF L-TRIIODOTHYRONINE ON GROWTH AND RADIOSENSITIVITY OF TUMORS. REPORT 2. Takayoshi Shima (Tottori Univ., Yonago, Japan). Nippon Igaku Hoshasen Gakkai Zasshi, 22: 1211-15(Feb. 25, 1963). (In Japanese)

The effects of L-triiodothyronine (T_3) in large doses on the growth and radiosensitivity of tumors were studied. The mitotic rate of Ehrlich ascites carcinoma cells in mice was decreased by T_3 injection at dose levels of 20, 30, and 40 μg/mouse. The growth rate of transplanted mammary tumors in C_3H mice was decreased by injections of 20 μg T_3 every other day. The reduction of mitotic rate of Ehrlich ascites carcinoma cells in mice, caused by x irradiation, was enhanced and prolonged by injection of 20 μg T_3 immediately before irradiation, but T_3 injection 10 hr before irradiation did not produce a similar additive effect. The suppressive effect of irradiation on the growth of transplanted mammary tumors in C_3H mice was potentiated by the injection of 20 μg T_3 immediately before irradiation. These results indicate that T_3 may be clinically useful as a sensitizer in radiotherapy. (BBB)

38878 BONE MARROW DOSE IN FAST-NEUTRON IRRADIATION CALCULATED FROM GEOMETRICAL BONE STRUCTURES. PART I. Osamu Yamamoto (Hiroshima Univ.). Nippon Igaku Hoshasen Gakkai Zasshi, 23: 146-56(May 25, 1963).

On the basis of Spiers' theory, calculations of energy absorption by bone marrow were made for 14.1-Mev fast neutrons. In this calculation, unlike that for x rays and γ rays, the energy absorption at point P in a plane of bone marrow was calculated for only the effect on the bone and the soft tissues on the opposite side of point P from the neutron incidence direction. This is because proton scattering takes place in front of the site of collision with the neutron from the direction of the neutrons. As the result of these calculations, the energy absorption in bone marrow is shown to decrease with the decrease in distance from the interface between the bone and bone marrow toward the side of the neutron source. The energy absorption curves

obtained were different in shape from those of x rays. As the bone layer becomes thicker, the decrease in the energy absorption becomes more marked. With increase in bone thickness, the recoil proton energy of the bone is more effective for marrow energy absorption and at the same time the recoil proton energy of the outer tissue becomes less effective. The change in average energy absorption is shown. When the marrow layer thickness is fixed and the bone layer is variable, the decrease in energy absorption becomes greater with decrease in distance from the interface. The changes in average energy absorption, where the bone layers are semi-infinite and 50 μ, are compared for 250-kv x rays, ^{60}Co γ rays, and 14.1-Mev neutrons. In this analysis the effects of carbon, nitrogen, and oxygen atoms in soft tissues were not considered. Moreover, the distribution angle of protons produced secondarily from neutrons was not taken into consideration. Corrections should be made for these factors and a comparative experimental study attempted for the total marrow doses in small animals for x-ray, γ-ray, and neutron irradiation. (BBB)

38879 RADIO-STIMULATION STUDIES WITH POTATO. Andor Balint and Zoltan Menyhert (Univ. of Agrarian Sciences, Godollo, Hungary). Novenytermeles, 13: 153-60 (June 1964).

Studies have shown that any crop can be stimulated by irradiation if the source and dose are adequately chosen. The dose should be determined by preliminary experiments. The optimal dose is affected by the date and duration of irradiation, chemical composition, gas pressure, and temperature of the environment, the moisture content of the plant, and the source of the radiation. Stimulation increases almost linearly with the dose up to an optimal level. Above this, stimulation gradually decreases. Finally, when a relatively high mutation rate is reached, plant growth is inhibited and the plants are killed. With potatoes, the threshold dose of stimulation is between 10–100 R equivalents and optimal effect is obtained from a few hundred to 2000 R. Stimulation of potatoes resulted in the increase of total yield, and an average tuber weight and vitamin C content of the tubers. (OTS)

38880 TESTICULAR TUMORS IN NORMAL AND IRRADIATED RATS. C. C. Berdjis (Fort Detrick, Frederick, Md.). Oncologia, 17: 197-220(1964).

The frequency and histopathologic features of testicular tumors in normal and irradiated rats are presented and their occurrence and histologic variations compared with those of man and dog. The 156 rats studied had received total-body exposure of 500 R or 3 × 350 R x irradiation. Thirty-nine testicular neoplasms were found distributed according to age in the irradiated animals. Most of the testicular tumors were interstitial cell tumors (nongerminal) with only a small percentage of germinal tumors (seminomas). Control rats developed interstitial cell tumors only. Neither pure Sertoli cell tumors nor true teratomas were observed. The observed occurrence of precocious senescence with inevitable testicular atrophy, various degrees of arteriosclerosis, and changes in secondary sex characteristics suggested an impairment of testicular function late after irradiation. Whether or not tumorigenesis was due to hormonal imbalance, impairment of hormonal activity in general or to a functional deficiency of testis itself, created by irradiation, was not established. (OTS)

38881 USE OF ULTRAVIOLET-INDUCED SPORULATION FOR IDENTIFICATION OF PYRENOCHAETA TERRESTRIS. W. M. Hess, Edward K. Vaughan, and C. M. Leach (Brigham Young Univ., Provo, Utah and Oregon State Univ., Corvallis). Phytopathology, 54: 113(Jan. 1964).

Fourteen isolates of Pyrenochaeta terrestris were exposed to near-ultraviolet light in an attempt to get rapid, abundant sporulation. Cultures were grown on Watson's low nutrient medium containing propylene oxide-sterilized water for seven days prior to irradiation at room temperature. All 14 isolates formed pycnia with setae and spores within 12 days. Color formation and excessive mycelial growth were inhibited by irradiation. (H.M.G.)

38882 THE INFLUENCE OF GAMMA IRRADIATION ON THE WEIGHT AND SELENIUM^{75} MINERALIZATION OF THE TESTES AND SPLEEN OF CHICKS. H. Patrick and W. G. Martin (West Virginia Univ., Morgantown). Poultry Sci., 43: 780-2(May 1964).

The influence of sulfur compounds on prevention of radiation damage and the chemical relation or similarity of inorganic Se to inorganic S prompted the use of ^{75}Se in mineralization studies related to the influence of γ irradiation of chicks. White Leghorn chicks 24 days old were exposed to ^{137}Cs γ radiation at dose rates of 7 to 800 R/hr to total doses up to 1600 R. Seventy-two hours after irradiation each chick was given subcutaneously three μC of ^{75}Se, and 48 hr after radionuclide administration the chicks were sacrificed. The testes and spleen were removed, cleaned of adhering tissues, weighed, then assayed for ^{75}Se content. Hemorrhages of the legs of chicks receiving 1600, 1400, and 1200 R were observed 72 hr postirradiation. Feed consumption was less in the chicks receiving 1600 and 1400 R of irradiation. The testes and spleen were very sensitive to γ irradiation, showing changes even at levels as low as 200 R. The body wt of the birds receiving 1600 and 1400 R was less than that of lower dose groups. The amount of ^{75}Se present per organ in the spleen and testes followed the general pattern of size of dose response to irradiation. These results showed that the spleen is sensitive enough to γ irradiation that this organ might be used as a unit for measuring dose rate in chicks. (BBB)

38883 THE CYTOLOGIC RESPONSE TO RADIATION: PROGNOSTIC VALUE. Arturo Angel Arrighi. Prensa Med. Arg., 47: 2756-60(Oct. 1960). (In Spanish)

Cytologic changes were examined in 100 neoplastic cells; the response being manifest between the 10th and 14th day postirradiation. Cytologic changes are similar following intracavitary Ra therapy or externally applied radiotherapy and do not appear to be related to the tumor's histologic characteristics. In the further study the RR was investigated in 122 uterine cervical cancer patients following treatment with Ra and x radiation. The prognosis based on RR was compared with recurrence of neoplastic disease for a period of one year in some cases or two, three, or four years in others. Results showed that in 91 patients (75%) prognosis evaluated from RR coincided with clinical findings. Correlation was highest when the RR was rated as good. It was concluded that these results justify the use of the RR method in prognostic evaluation of the effectiveness of radiotherapy in cervical cancer. (OTS)

38884 TOLERANCE OF CARTILAGE AND BONE IN CLINICAL RADIATION THERAPY. Robert G. Parker (Univ. of Washington, Seattle). Progr. Radiation Therapy, 2: 42-66(1962).

A review of the field, covering 133 reports, indicates that tolerance of cartilage and bone to ionizing radiation may be related to several factors: unique anatomic structure; specific effect of bone on the absorption of radiation; age of the

structure, with attention to peculiarities of response during development and to possible effects of degenerative change; integrity of the structure, as related to invasion by neoplasm or alteration by previous resection; infection; trauma; and quality of the radiation. Radiation dosimetry in relation to the anatomic structure of bone is discussed. Attempts are made to calculate the doses on a microscopic scale at the interface between bone and soft tissue and with tissue-filled, bone-surrounded cavities of the size found in lacunae and Haversian canals. Development, diagnosis, and treatment of malignancies and other serious sequellae of irradiation of skeletal tissues are discussed. (OTS)

38885 ON ^{131}I-LABELED INSULIN. PART V. INFLUENCE OF IMMUNIZATION AND X RADIATION ON THE DISAPPEARANCE OF ^{131}I-INSULIN. Angelo D'Addabbo and Ekkehard Kallee (Universität, Tubingen, Ger.). Protides Biol. Fluids, Proc. Colloq., 8(1960): 255-8(1961). (In German)

In guinea pigs that had been immunized with bovine albumin, human serum, or Bence-Jones protein the blood disappearance of intravenous bovine ^{131}I-insulin was compared with its disappearance in nonsensitized animals. The dosage was from one to three units of insulin. Blood was sampled over the period 10 to 100 min following the injection. The disappearance curves were estimated as linear functions of time by appropriate modification of the axes of the plot. The blood disappearance of insulin was accelerated only in animals highly sensitized to bovine albumin, where it was dependent on the degree of sensitization. This suggests a specific reaction against bovine albumin. The effect of lethal x radiation on the behavior of the reticuloendothelial cells in sensitized animals was also studied. One week before irradiation the insulin blood disappearance was measured in animals highly sensitized to human serum. Reutilization of the insulin breakdown products and their accelerated urinary excretion was prevented by injection of KI solution just prior to the experimental period. The animals were irradiated 8 days later. The insulin disappearance was measured 18 to 24 hr after the radiation treatment. The radiation treatment increased the disappearance time of the whole blood radioactivity markedly, while the disappearance time of the blood radioactivity precipitable with trichloracetic acid was unaltered. In animals not sensitized the effect of radiation in accelerating insulin blood disappearance was less pronounced. These results indicate that the irradiated cells increase insulin breakdown or that the breakdown products are eliminated from the blood more slowly in irradiated animals. The sensitized animals were more susceptible to the lethal effects of radiation than the control animals. (BBB)

38886 CHANGES IN NEUROSECRETORY MATERIAL, WATER INTAKE, AND URINE OUTPUT IN X-IRRADIATED RATS. Adel K. Afifi, James W. Osborne, and C. L. Mitchell (Univ. of Iowa, Iowa City). Radiation Res., 23: 1-12(Sept. 1964).

Postirradiation diuresis did not always occur in rats after exposure of the whole body to 400 r of x irradiation. Furthermore, it did not occur preferentially on the first, second, fifth, or sixth postirradiation days. When it began, it had the tendency in some animals to persist. Polydipsia did not bear any relationship to polyuria. Although depletion of stainable material in the supraoptic nucleus and posterior pituitary was associated with diuresis in some animals, such a relationship was not predictable. (auth)

38887 AGE AND SENSITIVITY TO RADIATION LIFE SHORTENING. Horton A. Johnson (Brookhaven National Lab., Upton, N. Y.). Radiation Res., 23: 19-25(Sept. 1964). (BNL-7597)

A decrease in the γ radiation life-shortening effect in mice with increasing age at irradiation is a necessary consequence of the hypothesis that ionizing radiation accelerates certain of the processes that characterize natural aging. The relationship of relative life shortening to age at irradiation varies according to the form of the Gompertz function. Results of calculations using an IBM 7094 computer showed that age-dependent variation in either absolute or relative life shortening does not preclude an overlapping between natural aging mechanisms and the late somatic effects of ionizing radiation. (auth)

38888 EFFECT OF 2-β-AMINOETHYLISOTHIOUREA (AET) AGAINST GENETIC DAMAGES INDUCED BY X-IRRADIATION OF MALE MICE. A. Leonard and J. R. Maisin (Centre d'Étude de l'Énergie Nucléaire, Mol, Belg.). Radiation Res., 23: 53-62(Sept. 1964).

Male mice were given local irradiation over the testis, half of each group receiving AET before irradiation. Males were mated with virgin females for 7-day periods, the first, second, and seventh weeks after exposure. These periods correspond to irradiation of spermatozoa, spermatids, and spermatocytes, respectively. The females were dissected on the seventeenth day after the beginning of the mating, and the corpora lutea and live and dead embryos were counted. AET by itself slightly reduced fertility, but it also decreased the preimplantation loss from treated spermatogonia. Irradiation produced the expected reduction in fertility and increase in preimplantation and postimplantation death when spermatozoa and spermatids were given 400 R or 1200 R. There was no increase after spermatogonia were given 400 R. AET reduced significantly preimplantation loss in spermatids given 1200 R and slightly the postimplantation loss in spermatids given 400 R. The ratio of dead embryos to total implants was increased by irradiation of spermatozoa or spermatids. The increase was reduced by AET in all four comparisons, but only two were statistically significant. The over-all mutation rate was reduced by AET in a similar way. (auth)

38889 RESPONSE OF BURROS TO MIXED NEUTRON AND GAMMA IRRADIATION. U. S. G. Kuhn, III, Roy E. Kyner, Jr., and Daniel G. Brown (UT-AEC Agricultural Research Lab., Oak Ridge, Tenn.). Radiation Res., 23: 78-93(Sept. 1964).

Eighty-eight burros (Equus asinus asinus) were exposed to prompt neutron and γ-radiations from a nuclear detonation. The median lethal dose was determined to be 374 rads with 95% confidence limits of 336 to 410 rads. Because of the mixed nature of the radiation and the possible significance of dose rate, estimation of an RBE for neutrons is not justified on the basis of the findings. The mid-line dose of γ-rays in an especially prepared burro cadaver was found to be 70% of the free field dose. A high incidence of remarkable central nervous system symptoms and early mortality was observed. Otherwise, clinical reactions and postmortem findings were similar to those observed in studies with external total-body γ-irradiation of the species. (auth)

38890 RESTORATION OF VIABILITY OF X-IRRADIATED L-STRAIN CELLS BY ISOLOGOUS AND HETEROLOGOUS HIGHLY POLYMERIZED DEOXYRIBONUCLEIC ACID. Branimir Miletić, Danilo Petrović, Antun Han, and

Ljerka Šašel (Institute "Ruder Boskovic," Zagreb). Radiation Res., 23: 94-103(Sept. 1964).

Experiments in which x irradiated L-cells were treated with isologous and heterologous highly polymerized deoxyribonucleic acid (DNA) are described. Administration of isologous DNA after irradiation led to a significant increase in survival of the treated cells. Comparison of survival curves of nontreated cells and DNA-treated cells irradiated with doses ranging from 100 to 800 R led to the conclusion that addition of DNA produced an increase of the extrapolation number but did not influence the MLD. Administration of heterologous DNA gave a restorative effect similar to that of isologous DNA. This led the authors to conclude that a metabolic mechanism could be involved in the restoration phenomenon. (auth)

38891 RADIATION MORTALITY IN THE MOUSE: MODEL OF THE KINETICS OF INJURY ACCUMULATION. II. PROTRACTED DOSES IN THE SUPRALETHAL RANGE. S. Phyllis Stearner, Margaret H. Sanderson, and Sylvanus A. Tyler (Argonne National Lab., Ill.). Radiation Res., 23: 104-18(Sept. 1964).

A kinetic description of injury accumulation during irradiation in mice is presented for modes of death associated with the supralethal range. The LAF_1 mouse was exposed to ^{60}Co γ-rays for single periods ranging from 60 minutes to 1 day. Total doses from 900 to 3200 R were delivered. The time-dose pattern of mortality, taken together with the time of occurrence of intestinal lesions and bacteremia, supports the thesis that the predominant lethal mechanism expressed in 4- to 6-day mortality is largely distinct from that expressed in 6- to 9-day mortality. Thus the former is associated with the intestinal lesions, and the latter with bacteremia. The model that is presented assumes the independent action of time-dependent (reversible) processes, regulated by a linear reversal of radiation effects, and time-independent (irreversible) injury processes. The time-dependent mechanisms are expressed in groups exposed for periods of 360 minutes or less, whereas the time-independent injuries predominate in groups exposed for 960 and 1440 minutes. Mathematical description of the time-dependent processes indicated a distinct reversal constant was determined for each of three mortality periods: For the 9- to 30-day period, τ was previously described to be 1419 minutes. For mortality in the 4- to 6-day period, τ' was determined to be 719 minutes. For injury with which deaths in the intermediate 6- to 9-day period are associated, τ'' is 963 minutes. Sensitivity to the time-dependent effect expressed in the 4- to 6-day period is indicated by an LD_{50} of 1642 R; for the time-independent effect the estimated LD_{50} is 2838 R. For mortality expressed in the 6- to 9-day period, the estimated LD_{50} for an instantaneously delivered dose (time-dependent effect) is 1385 R; for the time-independent effect the estimated LD_{50} is 2369 R. (auth)

38892 INCREASED ENDOGENOUS RESPIRATION OF ASCITES TUMOR CELLS AFTER RADIATION EXPOSURE. Joseph A. Ontko and Wells R. Moorehead (Univ. of Tennessee, Memphis). Radiation Res., 23: 135-44(Sept. 1964).

Washed Ehrlich ascites tumor cells, harvested from mice 24 hours after 1250 R of whole-body x irradiation, exhibited a marked increase in endogenous respiration as compared to an equal number of control cells. Cell division was arrested by radiation exposure. The irradiated cells were larger and contained more nitrogen than did unexposed control cells. The radiation-induced elevation in endogenous respiration was somewhat less but remained significant when compared to control cells on an equal volume or equal nitrogen basis. Present information indicates that the observed increased respiration cannot at this time be attributed to uncoupled oxidative phosphorylation, increased level of substrate or other stimulatory agent in the ascites serum, elevated level of diffusible stimulatory agent in the cells, or increased concentration of rate-limiting oxidative enzymes. Kinetic evidence favors the possibility that the increased oxygen consumption is a result of an increased intracellular substrate concentration or an increased rate by which a storage form of substrate is converted to a form that is readily oxidized. (auth)

38893 EFFECTS OF IONIZING RADIATION ON THE ULTRASTRUCTURE OF COLLAGEN FIBRILS. A. J. Bailey (Univ. of Cambridge, Eng. and Agricultural Research Council, Cambridge, Eng.) and W. J. Tromans. Radiation Res., 23: 145-55(Sept. 1964).

Examination of irradiated collagen fibrils was carried out by electron microscopy by employing the negative staining technique. No irradiation-induced effects could be observed up to doses of 10 Mrads, but above this dose a gradual destruction of the fibril band pattern occurred until at 40 Mrads the cross-banding had completely disappeared. The effects of irradiation on the fibrils were compared with other physical and chemical treatments, such as hydrogen bond-breaking and chemical crosslinking agents. This comparison indicated that the loss of pattern is primarily due to swelling of the fibrils resulting from disorganization of the collagen macromolecule and the subsequent ingress of water. Evidence was obtained that intermolecular crosslinks were produced when the fibers were irradiated in the presence of water. In contrast to this, irradiation in the dry state resulted in fragmentation of the macromolecule. (auth)

38894 ERYTHROPOIESIS IN CANCER. 1. QUANTITATIVE EVALUATION OF ERYTHROPOIESES DURING TELECOBALT THERAPY. F. di Pietrantonj. Radiazioni Alta Energia, 2: 11-30(Jan. 1963). (In Italian)

Erythrocytarian production, determined by the relation between erythrocytarian mass and average cell life, was studied in patients suffering from carcinoma of the uterus who underwent telecobalt therapy. Radiation treatment has not proved to influence the life of the red corpuscles in the sense of causing an increase in erythro-destruction. Erythro-production proved to be normal and even increased in many cases, while in a few it was found to be decreased. A decrease in erythrocytarian production is present in subjects with extensive neoplastic invasions, for which the fundamental disease justifies by itself the uncompensated hyperemolysis. In four subjects, however, the fall in the hemocritus during the treatment, and the absence of any clinical sign of neoplasia for more than one year since the end of the treatment, and in addition the reestablishment of normal values of hemocritus at a distance from the treatment, speak for an anemia-producing action on the part of the radiations. The contradictory nature of the data noticed in more than 40 subjects studied is explained on the basis of the theory of stress. (auth)

38895 NERVOUS PERIPHERAL LESIONS AFTER TELECOBALT IRRADIATION OF PELVIC CAVITY. S. Massenti and M. Laddaga (Università, Pisa, Italy). Radiazioni Alta Energia, 2: 123-39(July 1963). (In Italian)

Two cases of nervous peripheral lesions with bilateral concern of crural and sciatic nerves that occurred months

after ^{60}Co irradiation for cervical carcinoma are described. On the ground of clinic elements, among which is the course of disease (both the patients are examined periodically since 4 years), there is close agreement of the presumable center of the nervous lesions and the intensely irradiated area. The typical latent period between the irradiation and the occurrence of neurological symptoms are attributed to the same irradiation. This opinion is confirmed in acquisitions pertinent to the radiobiology of nervous system that aim at attributing to the nervous structures a degree of radiovulnerability superior to that was considered formerly. (auth)

38896 ON THE EFFECT OF TRACER DOSES OF SOME RADIOISOTOPES ON THE ORGANISM. O. S. Sergel, I. S. Kas'janov, N. K. Svindov, and I. N. Birukov (State Scientific Research Inst. for X Radiology, Moscow). Radiobiol. Radiotherap., 3: 319-24(1962). (In German)

It is commonly believed that small quantities of radioisotopes are not injurious to the organism. This outlook leads to uncritical usages of radioisotopes for diagnostic purposes in children, old people, and weakened patients. Contrary to this belief, it has been found that the radiation effect alone can produce changes in organs and functions. Effects of ^{32}P, at dose levels of 20 μC and 2 mC in humans, were observed in blood. Nuclei of the leukocytes showed altered fluorescent responses 10 days after ^{32}P administration. The leukocyte counts increased initially but dropped to ~70% of normal within three days. Thrombocytes decreased similarly. In polycythemic patients the red cell count and hemoglobin concentration decreased within one day after ^{32}P administration. In 63% of the cases studied ~ half of the neutrophils were granulated, and sometimes pyknotic cell nuclei, vacuolation of cytoplasm, or immature marrow cells were observed. Similar studies in rats and guinea pigs with from 0.5 to 2 μC of ^{131}I or ^{24}Na indicated decreases in red cell counts of up to 40% by the third day after treatment. Numerous changes in fluorescent microscopic tissue responses were observed, indicating effects of the radioisotopes on cell components. Several organs including liver, spleen, tests, and ovaries, were studied in vitro. Sections of the organs were photographed before and after addition of 0.58 μC ^{131}I. Within a few minutes of radioisotope addition the capillary lumens constricted in spasm. The leukocytes tended to clump and collect along the vessel walls. These changes were not observed in sections without ^{131}I. At the present level of investigation of these phenomena it is not possible to evaluate the threshold tracer concentration of radioisotope that will produce these effects. The results suggest that even very small doses may produce these effects in tissue, and for this reason the use of radioisotopes for studies in children is not recommended. (BBB)

38897 STUDIES ON THE GERMINATION OF TOBACCO SEEDS IRRADIATED BY NEUTRONS AND GAMMA RAYS. G. S. Murty and K. V. Krishanamurty (Central Tobacco Research Inst., Rajahmundry, India). Sci. Cult. (Calcutta), 28: 428-31(Sept. 1962).

As a preliminary program in mutation breeding, seeds of some select varieties of flue-cured tobacco were subjected to irradiation by neutrons or γ rays (^{60}Co). Threshold doses for good germination and survival were determined, the effect of different doses on germination was compared, and the effect of storage on irradiated seeds was evaluated. Three varieties (Chatham, Delcrest, and Hicks) were irradiated with 1×10^{12} to 2.5×10^{13} N cm^2/sec doses of thermal neutrons in the atomic reactor. The radiation dose was a mixture of thermal and fast neutrons including about 10% of γ-ray contamination. The seeds were subjected to ^{60}Co treatment at doses of 5000 to 144,000 R. Doses of 2.5×10^{12} N cm^2/sec of neutrons and doses of 20,000 R of γ rays respectively are the optimum doses for seedling survival. Doses 5×10^{12} of neutrons and 27,000 R of γ rays are the thresholds between complete and incomplete germination. Values for percentage of germination at different doses ran parallel for the two irradiations. Varietal response was significant in the neutron-treated seeds, the variety Hicks showing the highest survival capacity. The germination of irradiated seeds improved on storage and with certain doses seed viability was prolonged beyond that of untreated normal seeds. For example, in Hicks variety, 5000-R-treated seeds showed 98% germination after 20 months of storage while the control seeds stored for the same period showed only 80%. Among the surviving seedlings of neutron doses of 1×10^{12} and 2.5×10^{12}, abnormalities of seedlings such as mis-shaped cotyledons, hypocotyl deformity, and third leaf malformations were evident. The Hicks variety showed a high percentage of such abnormalities. (BBB)

38898 THE CYTOLOGICAL EFFECTS OF X IRRADIATION ON THE TESTES OF THE MONKEY MACACA MULATTA WITH SPECIAL REFERENCE TO COMPARISON OF CYTOLOGICAL AND HISTOLOGICAL OBSERVATIONS. T. C. Chang, S. Y. Chao, C. C. Tan, and T. T. Liu (Futan Univ., Shanghai). Shih Yen Sheng Wu Hsueh Pao, 8: 185-91(May 1963). (In Chinese)

Observations on the frequencies of chromosome aberrations in the first meiotic anaphases of testes of the monkey following 200-R of x radiation are reported. For comparison, the testes were biopsied at different intervals after irradiation (5, 10, 20, 30, 40, 50, and 60 days). The results were compared with earlier histologic observations on the same materials to determine whether the two methods, cytologic and histologic, complement each other in identifying the effects of x irradiation on spermatogenesis in the monkey. Throughout the series of observations made from five to 60 days after exposure to 200 R, the spermatogenic process was apparently disturbed in each monkey as compared to the controls, though the degree of changes varied in different monkeys. The damage in 20- to 30-day specimens after irradiation was apparently the heaviest, since in this period not a single spermatocyte of the first meiotic anaphase could be identified; also noted were marked chromosome aberrations. At the 50th day after exposure, recovery was obvious. Hence, it is inferred that the completion of a single cycle of spermatogenesis in the monkey probably takes about 50 days. Since chromosomal aberration frequency was highest in the 10-day specimen, this interval may be taken as a useful index for the purpose of comparative radiosensitivity studies. The results obtained here agreed well with those previously reported. (OTS)

38899 THE EFFECT OF GAMMA RADIATION ON THE MICROBIAL POPULATION OF THE SOIL. Hugh Popenoe and Charles F. Eno (Univ. of Florida, Gainesville). Soil Sci. Soc. Am. Proc., 26: 164-7(Mar.-Apr. 1962).

A fine sandy soil (Arredondo) was exposed to ^{60}Co γ radiation at doses of 1, 4, 16, 32, 64, 256, 512, 1024, and 2048 kR. Percentage survival of fungi and bacteria decreased with each increase in radiation dose to <4% at 1024 kR. Algae were not as drastically reduced in numbers as bacteria and fungi: some survived at 2048 kR and greatest reduction occurred above 64 kR. A few nematodes remained in the soil 2 days after irradiation with 1024 kR, but none

were recoverable from exposure to doses >256 kR after 14 and 28 days. The effects of lower doses were not resolvable. Carbon dioxide evolution was initially reduced by irradiation of the soil, but was later recovered. Nitrate production in a 14-day period was progressively reduced by increasing doses of radiation. Recovery from 32 kR or less occurred in 28 days. This study indicates that the specific effects of γ radiation on selected groups of microorganisms may have an important effect on the fertility of the soil, but these changes must be investigated further to determine how much they may affect studies where soil is irradiated and subsequently used as a growth medium for plants. (OTS)

38900 DIFFERENTIAL EFFECTS OF REGIONAL OXYGENATION ON THE RADIATION SENSITIVITY OF NORMAL TISSUE VERSUS VX2 CARCINOMA IN THE RABBIT HIND LIMB. Manuel S. Tayao, Paul Clapp, K. K. N. Charyulu, James J. Nickson, and Walter Lawrence, Jr. (Sloan-Kettering Inst., New York). Surg. Forum, 14: 125-6(1963).

An experiment was designed to determine the differential effects of radiation on normal tissues and tumor tissues under varying conditions of oxygenation. Randomly bred rabbits were utilized 10 to 14 days after transplantation of VX2 carcinoma into the gastrocnemius muscle of both hind limbs. A single x radiation treatment of varying dosage was directed to one limb, and the tumor on the opposite limb served as a control. Radiation was administered under the following conditions: (1) normal undisturbed limb circulation with rabbit breathing air; (2) isolated limb perfusion with small disc oxygenator and gas mixture 99% O_2, 1% CO_2; (3) continuous arterial infusion of limb with dilute hydrogen peroxide solution (0.12% at 0.3 ml/kg/min flow); (4) isolated gaseous O_2 perfusion of the limb (50 to 90 mm Hg at 3 to 6 ml/min); and (5) hypoxia of limb with occlusive tourniquet. Radiation response with normal circulation in this rabbit tumor system indicated a significant incidence of toxicity in the normal tissues at doses above 2000 R. At 2000 R, appreciable tumor response did occur, but no tumors were completely eradicated at dosage less than 2500 R, a dosage at which prohibitive toxicity occurred in one-third of the rabbits treated. With oxygenated perfusion, tumor response was somewhat greater in the control, and the degree of toxicity was similar for comparable radiation dosage. Decreased, rather than increased, tissue oxygenation was undoubtedly achieved with this technique due to the lower than normal flow rates of such perfusion circuits. With hydrogen peroxide infusion during irradiation (1000 R), tumor response was not significantly improved over that obtained in limbs treated at the same dosage with normal circulation. When the perfusion system utilized gaseous oxygen as the perfusion medium, postperfusion local tissue damage was severe and prohibited proceeding with the irradiation studies planned. Striking findings were achieved with hypoxia produced by temporary circulatory arrest. Prohibitive toxicity secondary to the irradiation did not occur at doses of 6000 R. The tumor response was marked in the 5000- to 6000-R range with a high incidence of cured tumors (5 of 9 rabbits). It would appear that hypoxia gives a beneficial significant differential between radiation response of the normal and tumor tissues. (BBB)

38901 VARIATIONS IN SERUM GLYCOPROTEINS FOLLOWING X-RAY THERAPY. V. Righi (Ospedale Civile, Ostiglia, Italy). Riv. Patol. Clin., 17: 837-42(Nov. 1962). (In Italian)

Various stresses and inflammatory agents are known to elevate serum glycoproteins. Studies were conducted in six patients with cancer being treated with x rays to determine whether irradiation, as an agent causing both stress and inflammation, induces similar changes in glycoproteins. The patients were subjected to 150- to 200-R single doses of x rays given in 29 to 38 fractions to give total doses of 4800 to 5600 R. Serum glycoprotein levels were estimated by the method of Graff, which gives normal values of 93 to 126 mg/100 ml serum. The protein-bound polysaccharide content was also determined on the basis of galactose and mannose, normal values varying from 12 to 16 mg/100 ml. Although total serum protein levels tended to fall after radiotherapy, both of the glycoprotein fractions began to rise, usually after nine to 12 irradiation sessions. In some cases the values rose 60 to 80%, whereas in other cases the rises were slight. The elevated values were maintained during and after the rest of the treatments were given. The elevation of serum glycoproteins following irradiation is interpreted on the basis of a nonspecific stress reaction. (BBB)

38902 IRRADIATION OF THE BLOOD: METHOD FOR REDUCING LYMPHOCYTES IN BLOOD AND SPLEEN. Benjamin A. Barnes, Gordon L. Brownell, and Martin H. Flax (Massachusetts General Hospital, Boston). Science, 145: 1188-9(Sept. 11, 1964).

Insertion of a beta-emitting source into the right atrium of the heart permits intensive irradiation of the circulating blood, with subsequent depletion of lymphocytes in the peripheral blood and lymphoid organs. (auth)

38903 NUCLEIC ACID BIOSYNTHESIS AND PHAGE T2 GROWTH IN ^{60}Co-IRRADIATED E. COLI B. Cheng-Wen Wu, Ming-Liang Lee, Mei-Shia Guo, and I-Hung Pan (National Taiwan Univ., Taipei, Taiwan, China). Tai-wan I Hsueh Hui Tsa Chih, 62: 218-25(Mar. 28, 1963).

To further investigate biochemical modifications induced by radiation, nucleic acid synthesis was followed after a 2000 R (sublethal) dose of irradiation was given Escherichia coli under both the presence and absence of oxygen. Also studied was whether the inhibition of DNA in E. coli B affects the yield of T2 phage, since host DNA plays a significant role in the synthesis of bacteriophage. Nucleic acid biosynthesis in the irradiated bacteria was followed colorimetrically and spectrophotometrically. The proliferation of T2 phage after irradiation was measured by the plaque count method. Results suggested that after the sublethal dose, DNA biosynthesis was inhibited for a period of at least 90 min, while RNA biosynthesis and growth remained intact. The inhibited DNA synthesis was followed by an accelerated rate of synthesis 90 min after irradiation; then a constant rate was reached about $7\frac{1}{2}$ hr later when the normal level was regained. The DNA inhibition phenomenon failed to appear when cells were irradiated at the same dose under the same conditions but with free oxygen removed during irradiation. Phage growth in irradiated bacteria showed no sign of inhibition, although there was some depletion of DNA in the phage particles. These results were discussed in terms of the radiation sensitivities of RNA and DNA, possible mechanisms of DNA inhibition, function of DNA, recovery of DNA biosynthesis, oxygen effects in irradiation, and phage multiplication in DNA-depleted bacteria. It is concluded that host cell DNA synthesis is not essential, or only slightly so, to the synthesis of bacteriophage DNA. (BBB)

38904 THE EFFECT OF PREWEANING STIMULATION ON THE SURVIVAL OF RATS FOLLOWING LETHAL GAMMA IRRADIATION. Albert Casey and John R. Fulkerson (Agriculture and Mechanical Coll. of Texas, College Station). Texas J. Sci., 16: 85-9(Mar. 1964).

Various studies have demonstrated that early stimulation

(e.g., handling, electric shock, temperature change) leads to heightened resistance to acute physiologic and psychologic stress. A large dose of radiation can be viewed as acute stress, thus a study was made to determine whether heightened resistance to such a dose of radiation is afforded by stimulation applied during the critical infantile period. For the first 15 days of life, Sprague-Dawley rats were subjected to a handling procedure, consisting of removing a pup from the nest, placing it in a glass dish for 3 min and then returning it to the nest. The remaining half of each litter (controls) were left undisturbed. Experimental and control subjects were given whole-body γ radiation for total dose of 1464 R. Earlier observations indicated that it is extremely rare for a rat to survive this dose for more than 5 days. The results indicated that infantile handling does not result in heightened resistance to acute irradiation. (C.H.)

38905 ATTEMPTS TO RADIOSENSITIZE TRANSPLANTED TUMORS WITH SOME PYRIMIDINE DERIVATIVES. R. I. Pol'kina, M. N. Bychenkova, and L. I. Zalesskaya. Tr. Inst. Onkol., Akad. Med. Nauk SSSR, No. 4, 102-7(1962).

The pyrimidine derivatives pentoxyl and metacil were employed for the radiosensitization of tumors. Ehrlich tumor and melanomas were grafted under the skin of 444 mice and 7 to 9 days after the transplantation the animals were divided into four groups of 10 to 20 animals each. Mice of the 1st group (controls) were given water. The animals of the second group were given water and were subjected to x-irradiation. Pentoxyl and metacil in an aqueous solution were given to the mice of the third group. The mice of the fourth group received pentoxyl and metacil in combination with radiation therapy. Single doses of 3,400 R were given for the Ehrlich tumor and the dose was 5,035 R for the melanoma. Effectiveness was determined by periodic measurement of the tumors and by weighing them at the conclusion of the test. The percentage of growth inhibition of the tumors in the group receiving pentoxyl and metacil in combination with irradiation was calculated in comparison with that of the control group. Intensification of the therapeutic action of irradiation was noted when it was combined with the administration of pentoxyl in doses of 30 and 100 mg/kg over a period of five days. The reinforcement of the action of irradiation was noted when pentoxyl was given in a dose of 80 mg/kg prior to irradiation for a period of three days. It was also noted that pentoxyl in a dose of 100 mg/kg during a period of three days had a sensitizing effect in melanoma. In animals receiving metacil in a dose of 80 mg/kg during the five days preceding irradiation, 70% inhibition of tumor growth was noted compared with the controls, and the tumor weight was half as great as in animals subjected to irradiation alone. Increase of the metacil by doubling the dose has not led to the increase of its sensitization action. The results as presented attest to the heightening of the therapeutic effect of radiation therapy after preliminary administration of pentoxyl and metacil. (auth)

38906 SOME EFFECTS OF γ-RAYS ON THE SEROLOGICAL AND PHYSICOCHEMICAL PROPERTIES OF LYOPHILIZED HUMAN γ-GLOBULIN. Charles A. Leone and George H. Sweet (Univ. of Kansas, Lawrence). Trans. Kansas Acad. Sci., 66: 575-70(1963).

The solubilities, thermolabilities, electrophoretic and ultracentrifugal properties, and serologic reactivities were studied for γ-irradiated, lyophilized human γ-globulins (HGG) of an assumed molecular weight of 156,000. The HGG was irradiated over a range of dosages up to 200 ev/m (electron volts per protein molecule). Samples that received radiation doses of less than 90 ev/m were as soluble as native HGG in neutral 0.85% NaCl. Samples that received higher doses exhibited a dose-related loss of solubility. Variation of pH did not greatly affect solubility, nor aid in the separation of damaged molecules from those that were undamaged. The native and irradiated HGG samples were studied serologically over the complete range of combining proportions of antigens and antibodies by means of the precipitin test. The serologic activities of irradiated samples relative to native HGG were determined by measurements of the displacement of precipitin curves (N/I values) and by measurements of the amounts of antigen-antibody precipitates formed at high antigen concentration (NP/IP values). The N/I and NP/IP values were similar for each irradiated sample and indicated that the serologic activity of irradiated samples decreased exponentially with the dose of irradiation. Partially damaged, thermolabile molecules were detected in irradiated samples by serologic and heat-inactivation analyses. The amounts of thermolabile material in irradiated samples were dose dependent. Electrophoretic and ultracentrifugal studies indicated that heating of irradiated samples resulted in the formation of soluble polymeric complexes. The values obtained for serologic activity of the heated-irradiated samples indicated that saline-soluble, damaged molecules were specifically involved in the formation of antigen-antibody precipitates in the region of extreme antigen excess. The irradiated samples were shown to contain at least three molecular types including thermostable, thermolabile, and serologically active, and thermolabile and serologically inactive forms. The exponential dependence of serological activity upon the radiation dose is consistent with the target theory of Lea; however, the target volume, predicted from the 37% dose, was found to be only one-half the volume expected for an all-or-none, one-hit process of inactivation. (BBB)

38907 ACTION OF IONIZING RADIATION ON PROTEIN SYNTHESIS. V. D. Blokhina. Usp. Sovrem. Biol., 57: 394-403(May-June 1964).

A review was made on the effects of radiation on protein synthesis. A distinction is made between changes involving metabolism in general and specific changes in protein synthesis arising in the organism under the action of ionizing radiation. Protein starvation due to disturbances of the activity of the gastrointestinal tract in radiation sickness, reduction in the synthesis of serum albumin under the effect of damaging doses of ionizing radiation, and disturbances of protein synthesis in cells as a result of radiation damage to RNA are discussed in some detail. Previous work on the restoration of the normal capacity for protein synthesis upon introduction of DNA, some oligonucleotides, RNA, and certain polyanions was reviewed. (auth)

38908 CONTENT OF ZINC IN THE SKIN IN RADIATION DERMATITIS. A. T. Sosnovskii (Belorussian Scientific Research Inst. of Dermatology and Venerology, USSR). Vestn. Dermatol. i Venerol., 37: No. 11, 35-7 (Nov. 1963).

The content of zinc in blood and skin of rabbits with radiation dermatitis was studied by the colorimetric method with a photometer. The dermatitis was induced by radiation conditions as follows: 200 kv, 4 ma, skin-focus distance 18 cm, without filter, dose intensity 55 R per min, overall dose 300 R. About one month after this treatment ulcerous radiation dermatitis was clearly ex-

pressed on the irradiated portion of skin. The content of zinc in the blood of experimental animals was somewhat greater than that of the controls, but the difference was not statistically significant (coefficient of reliability = 1.9). However, there was a significant difference in the zinc content in skin from controls, non-irradiated animals, and the irradiated skin of experimental animals (coefficient of reliability = 3.2). There was also a statistically significant difference in the zinc content in irradiated skin and non-irradiated skin surrounding the area of radiodermatitis (coefficient of reliability = 2.2). The mean content of zinc under various conditions was as follows: blood of controls, 806 ± 58 gamma %; skin of controls, 1126 ± 113 gamma; blood of experimental animals with limited radiation dermatitis, 1088 ± 141 gamma %; affected skin of experimental animals, 1840 ± 177 gamma %; apparently healthy skin surrounding dermatitic patch on experimental animals, 1312 ± 165 gamma %. (auth)

38909 THE EFFECT OF DIFFERENT DOSES OF PENETRATING RADIATION ON HEMOGLOBIN RECOMBINATION. S. E. Manoilov and V. P. Komov (Inst. of Chemistry and Pharmacology, Leningrad). Vopr. Med. Khim., 9: 530-1(1963). (In Russian)

Globin or heme solutions were x-irradiated by doses of 500 to 20,000 R. An initial dose of 1000 R caused a decrease of the amount of recombined hemoglobin after heme irradiation. However it was not proportional to the applied dose. After a dose of 15,000 or 20,000 R, this decrease reached 50% of the value in the nonirradiated samples. X-irradiation of globin with the same dose did not affect the amount of recombined hemoglobin. (H.M.G.)

38910 THE SIGNIFICANCE OF NEWER EXOGENOUS INFLUENCES FOR DEVELOPMENTAL INJURIES ON EMBRYONIC CELLS AND OVA AND THEIR PREVENTION. Richard Bayer. Wien. Med. Wochschr., 112: 763-8(Oct. 13, 1962). (In German)

The fertilized human ovum is especially sensitive to exogenous conditions during the first three months of intrauterine development. During this time interval of organogenesis, cell division and differentiation are quite susceptible to injurious effects from a wide variety of environmental influences. The physiological protection mechanisms that the fertilized ovum is provided with during its movement through the tubes, and after it becomes implanted in the uterus ensures some degree of undisturbed development. However, it is often difficult to tell whether death of the ovum or the occurrence of a teratological malformation in later life is a result of genetic or of exogenous factors. Radiation injury is an exogenous factor that produces a particular group of injuries. In the embryonal state these injuries can either cause death of the ovum or various disturbances of organ genesis. During early pregnancy these may affect, above all, the central nervous system. However, they may also be responsible for malformations of the extremities, such as microcephaly. Even 25 or 40 R can produce malformations, and doses above 60 R ordinarily produce malformations and abortion. With a more exact knowledge of organogenesis it might be possible to establish time intervals that would correspond to exact stages of development from which to estimate the probability of damage. This would be useful not only for studies where radioisotopes are increasingly used diagnostically, but also for x rays, which must be used extremely sparingly for diagnostic purposes during early pregnancy. Direct embryonal injuries may appear after years even though there may be no immediate evidence at the time of irradiation. (BBB)

38911 ON THE STORAGE OF RADIOACTIVE STRONTIUM. Manfred Fingerhut (Johannes-Gutenberg-Universität, Mainz). Z. Ernaehrungswiss., 4: 178-82(Feb. 1964). (In German)

The influence and storage of ^{90}Sr absorbed from the diet was studied in rats over five generations. The animals received carrier-free ^{90}Sr as the chloride in constant ratio to Ca (140 and 350 pC/g Ca). The uptake of ^{90}Sr in the growing animal's skeleton in the first generation may be described by the function $SU(1 - e^{-0.127t})$, where SU represents Sr units and t, time in days. In following generations an increased ^{90}Sr content was measured in the skeleton after 4 weeks of age. During growth this value drops exponentially to the maximum value of the first generation (second generation equation $SU(1 + e^{-0.0119t}) = SU_t$). Thus this decrease takes place more slowly than the increase in the first generation. It was determined that the discrimination factor between ^{90}Sr and Ca is not completely developed in the early stage of the growth period. The first generation factor ratio ($^{90}Sr/Ca$) is greater than the equilibrium by 0.21. Evaluation of the biological data showed no influence of ^{90}Sr contamination on growth, increase, and protein efficiency. For the first two generations no significant difference between the control group and the two (140 and 350 pC/g Ca) test groups with respect to life span was observed. (BBB)

38912 COMPREHENSIVE REVIEW OF MORPHOLOGICAL ALTERATIONS OF THE LIVER BY RADIATION. Vladimir Frydl (Regional Hospital, Teplice, Czechoslovakia). Z. Ges. Inn. Med. Ihre Grenzgebiete, 17: 624-9 (July 15, 1962). (In German)

Clinical and experimental studies of radioinduced liver injuries are reviewed. It is pointed out that a common source of liver injuries in man is poorly directed therapeutic irradiation of other organs. The contributions of radioisotopes and Thorotrast deposits to liver damage are also assessed. Results of liver irradiation experiments on guinea pigs and rats are reported. (TCO)

38913 LATE THOROTRAST INJURIES IN THE NECK IN THE FORM OF A PERITONSILLAR ABSCESS. U. Beermann and H. Schaefer (Hals-Nasen-Ohrenklinik and Roentgen-Radiumklinik der Staedt. Krankenanstalten, Aachen). Z. Laryngol. Rhinol. Otol., 40: 863-8(Nov. 1961). (In German)

A 47-yr-old man who was injected with Thorotrast in 1940 was admitted with a peritonsillar abscess. There was a direct relation between the spatial deposition of Thorotrast in the area and the location of the tumor. The extent of this deposition directly influenced the intensity of symptoms observed, such as difficulty in swallowing, test disturbances, hoarseness, headaches, and dyspnea. The deposited Throtrast was compactly infiltrated in the region of the neck, nasopharynx, and hypopharynx. The larynx and trachea were also involved. In the vicinity of Thorotrast deposits in the lower third of the neck the recurrent nerve was damaged, resulting in hoarseness and dyspnea. In the upper third of the neck paresis of the hypoglossal and glossopharyngeal nerve resulted in difficulty in swallowing. Recovery from these injuries could have been achieved by a radical resection of the Thorotrast deposits, but this was impracticable because of the widespread deposition of Thorotrast throughout the entire reticuloendothelial system. Furthermore, removal of the foreign-body granulomas in the neck presented extreme difficulties because of calcified deposits that had accumulated around the nerves and blood vessels in the area. The

only treatment possible consisted of palliative measures. (BBB)

38914 STUDIES ON THE DELIMITATION OF PLEIOTROPIA AND ABSOLUTE LINKAGE. Werner Gottschalk (Universität, Bonn). Z. Vererbungslehre, 95: No. 1, 17-24(1964). (EUR 1689.d). (In German)

Two x-ray-induced Pisum sativum mutants were processed which showed partial correspondence as regards their aberrations. The anomalies of the sterile, small-leaf mutant 180 A were not attribuable to a single muted pleiotropic gene but are caused rather by the individual effects of two closely linked recessive genes. The pleiotropic gene dim was responsible for a general reduction of the leaf and flower size and of the internode lengths, as well as causing certain development anomalies in the leading shoot. There was a multiple allelomorph of dim, namely dim^1, which produced the same anomalies in less pronounced form. The gene dim was muted at least twice and probably three times. The fertile mutant 176 A is homozygotous in dim^1; the sterile mutant 180 A has the multiple allelomorph and also the simultaneously muted adjacent gene for female sterility. The findings are interpreted as pointing to the presence of radiation-sensitive regions in the chromosomes of Pisum sativum. (auth)

38915 THE EFFECT OF X RAYS ON THE CENTROPLASM AND THE CYTOSOMES OF TISSUE CULTURE CELLS. Ernst Wendt (Universität, Bonn). Z. Zellforsch., 53: 172-84(1961). (In German)

Morphological changes in the cytosomes and centroplasm of chicken heart fibroblasts and amniotic epithelial cells grown in tissue culture media were observed by phase contrast microscopy following x irradiation. Biochemical changes that accompanied these alterations were not ascertained. The cytosomes were exposed to 600 to 800 R of x radiation at 40 kv. One hr after this treatment the externa of the larger (~4-μ dia) cytosomes appeared to be contracted, so that the internal bodies became free. This change was reversible, and the cytosomes reverted to their normal appearance after two hr. This change did not appear in the smaller cytosomes. In cells where the cytosomes are well developed, exposure to 300 to 500 R of x radiation resulted in rapid appearance of "subparticles" within 10 to 20 minutes after exposure. Their numbers increased rapidly until by 30 min after irradiation they filled the cytosome completely. These particles left the cytosome rapidly and became distributed within the hyaloplasm. This process may indicate a radiation effect to stimulate a process that is normally much slower. When a higher dosage of 1000 to 1500 R was used the cytosomes appeared to disintegrate into many small particles with 50 min after the radiation exposure, but after 4 to 7 hr these particles increased in size and formed cytosomes that appeared normal. Two hr after irradiation with 600 to 1000 R, vacuoles appeared in the centroplasm. These were 1.4 μ and seemed to contain water derived from the centroplasm by syneresis. These combined within the hyaloplasm, and were reabsorbed during the recovery phase. The fluidity of the centroplasm depends on the radiation dosage. No vacuoles appeared after 300 R, but after 500 to 1000 R they became more and more numerous. Above 3000 R the vacuoles were never completely reabsorbed. The latency period increases with increasing dose. After exposure to 500 R fluidity returns after 3 to 5 hr, but after 2000 R the latent period is 10 to 15 hr. Vacuole formation is dependent on the transport capacity of the cytoplasm, and can take place only as long as energy-producing processes are available in the cell. (BBB)

38916 ON THE MORPHOGENESIS OF ACUTE RADIATION INJURY IN RAT SPINAL GANGLIA AFTER RADIATION WITH 185-Mev PROTONS. Karl Hermann Andres, Boerje Larsson, and Bror Rexed (Universität, Kiel). Z. Zellforsch. Mikroskop. Anat., 60: 532-59(1963). (In German)

Spinal ganglia of rats were radiated locally with a dose of 20,000 R of energetic protons. The acute radiation damage that appeared during the first 18 post irradiation days was evaluated by the phase contrast microscope and by electron microscopy after fixation in OsO_4 and embedding in methacrylate. The histopathologically measured course of the acute radioinduced reaction took place in three stages. (TCO)

38917 ELECTRON MICROSCOPE STUDIES OF STRUCTURAL CHANGES IN THE NUCLEI OF SPINAL GANGLIAL CELLS OF THE RAT AFTER IRRADIATION WITH 185-Mev PROTONS. Karl Hermann Andres (Universität, Kiel). Z. Zellforsch. Mikroskop. Anat., 60: 560-81(1963). (In German)

Morphological structural changes in rat ganglion cell nuclei were studied by means of phase contrast and electron microscopy for the interval of 18 hr to 17 days after proton radiation amounting to 20,000 R. Results indicate that the initial specific radiation injury to the ganglial cell nucleus is similar to the "mitotic degenerations" in the interphase nucleus, where primary damage is an effect on the DNA and RNA systems. Alternatively, significant reactions of the cytoplasm and general tissue damage must be the basis of the picture that appears later as a reaction to radiation. (TCO)

38918 ELECTRON MICROSCOPE STUDIES OF STRUCTURAL CHANGES IN CYTOPLASM OF SPINAL GANGLION CELLS OF THE RAT AFTER IRRADIATION WITH 185-Mev PROTONS. Karl Hermann Andres (Universität, Kiel). Z. Zellforsch. Mikroskip. Anat., 60: 633-58(1963). (In German)

Irradiation with 185-Mev protons for a total exposure of 20,000 R produced a series of characteristic changes in cytoplasm of spinal ganglial cells in rats. At an early time during an initial and intermediate stage of damage observed, changes in the Nissl bodies were superimposed upon the typical chromatolytic reaction produced. These consisted of a fine granular or particulate degeneration of the ergastoplasm and increase of the neurofilaments. In the final stage of radiation injury extremely chromatolytic forms predominate. These are typified by widespread disappearance of the Nissl bodies and vacuolation of the residue of the endoplasmic reticulum. Often the toxic-chromatolytic process becomes a necrobiosis that finally leads to disappearance of the perikarya affected. One indication of extremely heavy cell damage is separation of the ribosomes from the ergastoplasm before dissolution of the reticulum and their collection into a single structural mass at one pole of the cell. During the chromatolytic process the mitochondria fracture and become rounded off. Vacuolar transformations of the chondrioma are usually not very pronounced, and they do not occur during the third, degenerative stage of acute radiation injury. The lamellar, pyknotically altered mitochondria and the forms that show cristae destruction and vesical formation, which are apparently radiation specific, do not have ability to expand. The specific forms of chromatolysis and destruction of the ergastoplasm indicates radioinduced damage to these cytoplasmic components by action on the protein-forming systems. The transformations of the mitochondria especially appear to denote a disturbance of the energy metab-

olism in the perikarya. In the degenerative stage of acute radiation injury the specific changes are obscured by inflammatory and hypoxic reactions of the circulatory system. References cited, 41. (BBB)

38919 ELECTRON MICROSCOPIC STUDIES OF STRUCTURAL ALTERATION OF THE NERVE FIBERS IN RAT SPINAL GANGLIA AFTER RADIATION WITH 185-Mev PROTONS. Karl Herman Andres (Universität, Kiel). Z. Zellforsch. Mikroskop. Anat., 61: 1-22(1963). (In German)

After irradiation with 185-Mev protons, direct injuries to the axial cylinders of the ganglionic nerve fibers were not detectable with the electron microscope. The changes in the axon corresponded morphologically to the cytoplasmic injuries in the perikarya. Proliferation of neurofibrils and lamellar-pyknotic mitochondrial transformations appeared in the axial cylinders. The neurofilaments were deposited so thickly that they formed filament bundles. The mitochondria and lamellar bodies formed sediments that occupied the entire length of the axon. Another form of axon injury was complete disintegration of the neurofilaments and tubuli. The mitochondria were rounded and their cristae formed small vesicles. These changes were derived from autolytic and necrobiotic reactions of the perikarya. Retractions of the Schwann cells in the region of the Ranvier constrictions and isolated cell necroses lead to spotty denudation of the axons and extended from the basal membrane to the endoneural collagenous fibril plexus. In damaged medullary Schwann sheaths, myelin clumps were found. Often the axial cylinder was displaced toward the margin of the Schwann cells. Myelin destruction was carried out by macrophages that transfer the myelin globules from the Schwann cells. The macrophages also invaded the basal membrane cortex of the fibers. The myelin was fused into vacuoles with thickened membranes (phagosomes). The radioinduced degeneration of the Schwann sheaths of ganglionic nerve fibers appeared to have no important effect on the morphologic state of the associated axons. The localized degeneration of the myelin sheaths in the irradiated ganglia gave the appearance of segmental fiber disease, that, in view of the direct radiation injuries of the Schwann cells, may actually be caused by the general inflammatory tissue disease with its severe vasculopathy. (BBB)

38920 ELECTRON MICROSCOPIC STUDIES OF STRUCTURAL CHANGES IN BLOOD VESSELS AND ENDONEURIUM IN SPINAL GANGLIA OF RATS AFTER RADIATION WITH 185-Mev PROTONS. Karl Hermann Andres (Universität, Kiel). Z. Zellforsch. Mikroskop. Anat., 61: 23-51(1963). (In German)

Lumbar spinal ganglia of rats were exposed locally to a dose of 20,000 R from 185-Mev protons. Acute changes were observed in the ganglionic vascular net during the postirradiation period from 18 hr to 17.5 days. There was generalized endothelial distension, with increase of vesicles in the cytoplasm, and pronounced formation of microvilli within the surface toward the blood vessel lumen during the period 18 to 42 hr. In the chromatin of the endothelial nuclei, clear areas, up to 200 mμ in size, frequently appeared. Contrasting granular material became deposited within the cells of the vessel walls and beneath the basal membrane. In the intermediate and degenerative stages of radiation injury (2.5 to 4.5 and 6.5 to 17.5 days) there was extensive shrinkage of the endothelium, capillary dilatation, extravasation, and vascular thrombosis. Cell necrosis and fibrinotic atrophy was observed in the vessel walls. In prepared sections of the vessel walls the fibrin filaments were aggregated to form crystalloids, which were also visible under the light microscope. These crystalloids consisted of hexagonal needles, where single filaments had lengthwise cross-sectional periodicity of 220Å. The morphological findings did not indicate the reason for the radioinduced vascular changes. The cell fragments phagocytized by histiocytic endoneural cells were accumulated in large phagosomes. The transformation of these polymorphic cytoplasmic inclusions into vasculated bodies suggests evidence of enzymatic degradation. (BBB)

38921 MORPHOLOGICAL CHANGES OF B. SUBTILIS AFTER TELECOBALT-60 RADIATION. Wolfgang Ritzerfeld and D. H. Winterhoff (Wilhelms-Universität, Münster, Ger.). Zentr. Bakteriol. Parasitenk., Abt. I. Orig., 192: 328-35(1964). (In German)

Agar plates of Bacillus subtilis were exposed to a total of 82,000 R of radiation from a ^{60}Co source, administered during a period of 6 hr. Effects of the radiation were studied photomicrographically in preparations that were obtained immediately after the radiation exposure and for 8 hr thereafter, preparations obtained each 24 hr for 5 days after the radiation, and preparations of the first and second subcultures obtained after 24- or 48-hr incubation. The irradiated preparations were compared with nonirradiated control plates of B. subtilis. In the samples examined immediately after exposure to radiation the cultures had a normal appearance, with no evidence of degeneration, although there was some chain formation as compared to the normal plates. After 32 hr the irradiated plates showed thread formation, with thickening, clump formation, and a large number of cell fragments and spores. Clumping increased, and distended and coccoid forms were visible 118 hr after radiation exposure. By 200 hr after irradiation there were few vegetative forms visible, but many spore forms were visible in both control and irradiated colonies. After 10 days the irradiated cultures and their subcultures continued to show marked pleomorphism, as evidenced by the extensive thread and chain formation, clumping, and the aberrant forms observed. It could not be ascertained whether some of these changes were due to disturbances in cell fission or presence of a relatively nonvital chain mutant. The clump formation suggests some general cell damage, for past studies have suggested that dying cells tend to produce clumping. (BBB)

38922 ON THE DELAYED RESULTS OF RADIOTHERAPY OF CARCINOMA. H.-J. Beerboom (Staedtische Krauenklinik, Luebeck, Ger.). Zentr. Gynaekol., 84: 403-6 (Mar. 17, 1962). (In German)

An 85-yr-old female patient was first treated in 1935 with a 2700 mg-hr dose from a Ra implant for a portio carcinoma of Group III type. The 90 mg of Ra was inserted for 3 hr with filtration of 1.5 mm of brass and at a distance of 5 mm. Subsequent examinations over the following yr showed no evidence of renewed malignant growth. However, a recurrence observed during the second post-treatment year was retreated with an 1800 mg-hr Ra dose from an implant, and 2400 R of x radiation. Intestinal hemorrhages were observed one yr later. In 1938, because of infiltration from the right parametrium to the pelvis wall and rectal stricture, the patient was given 15 x-ray treatments of 360 R each. After four months the hemorrhages ceased, but the rectal stricture remained, and some infiltration of the right parametrium was observed. A rectal examination 1.5 yr after the x-ray treatments showed scarification on

the right toward the pelvic wall, with fixation of the rectum near the left pelvic wall. There was no tumor growth. Rectoscopy indicated a rectal ulcer, and x rays of the colon showed polyposis of the large intestine and colon. Kidney function was normal and the bladder was not inflamed. Hemorrhage occurred frequently over the past 20 yr. In 1960 a rectal fistula appeared, with no evidence of carcinoma. The interval between radiation treatment and fistula appearance was 25 yr; the longest period previously reported for this type of fistula to occur is 22 yr. It was difficult to account for the unusually late appearance of this radioinduced fistula, because there were no reports on the mucosal changes or the exact amounts of radiation used. The intestinal hemorrhages and the rectal stricture indicated intestinal injuries. This is evidence for a mucosal ulcer within the deep walls of the rectum. Probably the combination of normal aging of the blood vessels and connective tissue and the radiation damage together were sufficient enough to produce necrosis and tissue degeneration which led to formation of the rectal fistula. (BBB)

38923 THE COURSE OF FOCAL STAPHYLOCOCCAL INFECTION IN WHITE RATS AT LONG INTERVALS AFTER WHOLE-BODY X-RAY IRRADIATION. M. D. Abdullaev, A. D. Kazaryan, and A. D. Sattar-Zade (Azerbaydzhan Scientific Research Inst. for Roentgenology and Radiology, USSR). Zh. Mikrobiol., Epidemiol. i Immunobiol., No. 6, 107-11(1964).

White rats that had recovered from radiation illness were inoculated at 3, 6, and 12 months after general irradiation (510 R) with focal staphylococcal infection (500 million microbial bodies into each testis). The course of the infection proved to depend closely on the length of the interval since irradiation. In rats inoculated 3 and 6 months after irradiation, the infection process was severe and generalized; mortality was 8.5 and 2.8%, respectively. Natural resistance to the focal staphylococcal infection had become normal after a 12 month interval, and the reaction of irradiated animals was almost identical to that of the control group. (OTS)

38924 INFLUENCE OF RADIOACTIVE SODIUM-24 ON HIGHER NERVOUS ACTIVITY OF DOGS, WHEN CHRONICALLY ADMINISTERED INTO THE ORGANISM IN COMPARATIVELY SMALL DOSES. B. I. Shalnev (First Sechenov Medical Inst., Moscow). Zh. Vysshei Nervnoi Deyatel'nosti im. I. P. Pavlova, 13: No. 1, 88-97(1963). (In Russian)

The action of a 50 μC dose of radioactive ^{24}Na on the higher nervous activity of dogs of different nervous system types, when administered six times into the organism during four and a half months, was studied. The dose of isotope used, while not producing any visible pathological deviations in the general state of the animals, lead to marked functional shifts in the cerebral cortex. Changes in the neurodynamics are of a sharply wave-like nature with parabiotic phases and are attended with a weakening of internal inhibition. The degree of intensity and the duration of disturbances depends to a considerable extent on the type of the animal's nervous system. Functional disturbances occurring in the cerebral cortex are of a reversible nature. (auth)

38925 IMMUNOLOGICAL REACTIVITY OF ANIMALS TO ANTHRAX CULTURE GROWN ON AN IRRADIATED MEDIUM. I. F. Batyuk. p.218-23 of "Gigienicheskii Normativy i Oxdorovienie Vneshnii Sredy." Kiev, Gosmedizdat, 1961.

The growing of anthrax pathogen (the strain Ovtsa 1930 in meat-peptone bouillon irradiated with x rays led to a change in morphological, cultural, pathogenic, and immunogenic characteristics. Two variants of the cultures were isolated from the original strain — the S-form and R-form. The former lost its immunogenic properties completely. Following immunization of rabbits with the R-form culture (17–18 million spores subcutaneously), 50% of the animals survived subcutaneous administration of $3DL_{50}$ of the virulent culture. The changes were transmitted permanently by heredity. (Referativnyy Zhurnal, Biologiya, No. 3, Feb. 1964)

38926 BIOLOGICAL EFFECTS OF NEUTRON AND PROTON IRRADIATIONS. VOLUME I. Proceedings of the Symposium Held at the Brookhaven National Laboratory, Upton, New York, 7-11 October, 1963. (International Atomic Energy Agency, Vienna). Proceedings Series. Mar. 1964. 440p. (STI/PUB/80(Vol.I)). $9.00; SCH 189.-; 54s.stg; F.fr. 36.-; DM 31.50(IAEA).

Separate abstracts were prepared for 19 papers presented at this symposium. Abstracts were previously prepared for 11 papers and appeared in NSA as: 17: 38886, 38887; 18: 1371, 1373, 4947, 8100, 9934, 17481, 17482, 31639, 33286. (C.H.)

For abstracts of individual papers see: 38725, 38726, 38727, 38728, 38729, 38730, 38731, 38732, 38927, 38928, 38929, 38930, 38931, 38932, 38933, 38934, 38935, 38936, and 39689.

38927 SOME RESULTS OF THE RESEARCH WORK ON THE BIOLOGICAL EFFECT OF NEUTRONS AND PROTONS. Yu. I. Moskalev. p.181-93 of "Biological Effects of Neutron and Proton Irradiations. Vol. I." Vienna, International Atomic Energy Agency, 1964. (In Russian)

The author correlates and analyzes the experimental data obtained over the past two or three years regarding the biological effects of neutrons and high-energy protons, and shows that it is a matter of prime concern for present-day radiobiology to investigate the relative biological effectiveness of the various types of radiation under various irradiation conditions and the reasons for the qualitative differences in their effect on the animal organism. Attention is drawn to the need for more research into the combined effect of various types of radiation and other agents. Specific examples are cited to demonstrate the main progress achieved in studying the prophylaxis of radiation injury induced by neutrons or high-energy protons and to show the contribution such research can make toward understanding the specific way in which various types of radiation act. (auth)

38928 DETERMINATION ON MICE AND OTHER ORGANISMS OF THE RBE OF HIGH-ENERGY PROTONS AND ELECTRONS. P. Bonet-Maury, J. Baarli, T. Kahn, G. Dardenne, M. Frilley, and A. Deysine (Institut du Radium, Paris). p.261-77 of "Biological Effects of Neutron and Proton Irradiations. Vol. I." Vienna, International Atomic Energy Agency, 1964. (In French)

The general effects of 157- and 592-Mev protons and 150- and 950-Mev electrons were observed on mice exposed to lethal doses of whole-body irradiation. The irradiated animals displayed the same general symptoms as those produced by x or gamma rays. The biological tests did not bring to light any particular phenomenon which can be considered as characteristic of these high-energy particles. As determined in four tests (LD_{50}, average expectation of

life, and diminution of thymus and testicles), the RBE is close to 1. This corresponds to the mean LET of the particles and, in the case of the protons, does not appear to be increased by the higher local LET of the spallation fragments. (auth)

38929 CLINICAL EFFECTS CONSEQUENT ON THE EXPOSURE OF MAMMALIAN OCULAR TISSUES TO HIGH-ENERGY PROTONS. S. C. Rexford-Welch (Air Force School of Aerospace Medicine, Brooks AFB, Tex.). p. 287-95 of "Biological Effects of Neutron and Proton Irradiations. Vol. I." Vienna, International Atomic Energy Agency, 1964.

The deleterious biological effects consequent upon exposure of mammalian tissues to bombardment by energetic protons were investigated and a realistic RBE is postulated for cataractogenesis. Experimental details whereby the critical organ (ocular tissue) of a significant number of monkeys (macaca mulatta) were exposed to focal proton irradiation, with energies ranging from 14 to 730 Mev and doses from 125 to 4000 rad, are outlined. Clinical findings to date, both for acute and chronic effects, are discussed and early indications of possible irreversible cerebral damage, in the higher dose range, are described. (auth)

38930 LOCAL LET SPECTRA IN TISSUE FOR SOLAR FLARE PROTONS IN SPACE AND FOR NEUTRON-PRODUCED RECOIL PROTONS. H. J. Schaefer (Naval School of Aviation Medicine, Pensacola, Fla.). p.297-306 of "Biological Effects of Neutron and Proton Irradiations. Vol. I." Vienna, International Atomic Energy Agency, 1964.

The problem of exposure hazards from solar-particle beams in space has created considerable interest in the determination of the rem/rad ratio for proton radiations with continuous energy spectra. Since these spectra, as the beam travels through an absorber, undergo continuous profound changes, the local rem/rad ratio in tissue has to be determined for true appraisal of the radiation burden. Assessing the RBE by integrating the ordinary LET values of the spectral components seems unsatisfactory because it does not consider the fine-structure of the energy dissipation created by secondary particles. A quantitative analysis of the differential LET spectrum and comparison to the corresponding spectrum of standard x rays would define the relative effectiveness much better. The differential LET spectra at different depths in tissue were analyzed for a typical solar-proton beam and for neutron-produced recoil protons from thermal fission. A comparison to the spectrum of standard x rays reveals a striking similarity for flare-produced protons whereas neutron-recoil protons exhibit a basically different LET spectrum centering heavily on high and very high values of local LET. Extending the analysis from actual space-radiation proton spectra to conceptual spectra of varying negative slope shows that the basic similarity to standard x rays is always preserved. It can be stated, then, that contrary to neutron-produced recoil protons the rem/rad ratio for proton beams in space will remain, for all types of spectra, well below 2. Recently reported findings of an RBE of 0.5 to 0.6 for producing acute radiation sickness in mice with monoenergetic protons of 660 Mev from an accelerator appear plausible from the differential LET spectrum of such protons which centers on LET values considerably below the maximum in the LET spectrum of x rays. In the composite LET spectra of flare-produced protons, the method of integration takes the low LET of these high energy components automatically into consideration. (auth)

38931 EFFECTS OF MONOENERGETIC NEUTRON RADIATION ON HUMAN CELLS IN TISSUE CULTURE. J. J. Broerse and G. W. Barendsen (Radiobiological Inst. of the Organization for Health Research TNO, Rijswijk, Netherlands). p.309-24 of "Biological Effects of Neutron and Proton Irradiations. Vol. I." Vienna, International Atomic Energy Agency, 1964.

Dose-effect relations concerning inhibition of clone formation by kidney cells of human origin in culture after irradiation with monoenergetic neutrons of about 3-Mev and about 15-Mev energy, are reported. For 3-Mev neutrons the dose rate was equal to 0.2 rad/min, while for 15-Mev neutrons dose rates of 2.7 rad/min and 12 rad/min were obtained. The cells were irradiated in culture dishes with a thin Melinex bottom and in small flexible nylon and silicon rubber tubes. Neutron fluxes were determined by measuring the activation of sulfur pellets mounted respectively between the dishes and the tubes. Calculation of the dose on the basis of the neutron flux presented a number of problems which are discussed. Because no radiation equilibrium exists around the cells, the resulting inaccuracies in the dose determinations are investigated. Dose-survival curves for both types of neutrons are presented. For 3-Mev neutrons an RBE was found ranging from 6.5 at low doses to about 3.1 at high doses, while for 15-Mev neutrons the RBE varied from 1.9 to 1.6. By comparison of these RBE-values with the RBE-LET relation obtained in earlier experiments with deuterons and α-particles, it is possible to derive an effective LET for the neutrons used. In order to elucidate certain problems related to the death of experimental animals after x- or neutron-irradiation, a technique was developed whereby the cells, contained in small tubes, are used to measure the effective dose (i.e., dose corrected for the RBE) at sites of interest in phantoms or animals. (auth)

38932 CHROMOSOME ABERRATIONS INDUCED IN HUMAN SOMATIC CELLS BY NEUTRONS. P. C. Gooch, M. A. Bender, and M. L. Randolph (Oak Ridge National Lab., Tenn.). p.325-42 of "Biological Effects of Neutron and Proton Irradiations. Vol. I." Vienna, International Atomic Energy Agency, 1964.

Freshly-drawn whole human blood was irradiated with various doses of 14-Mev D, T neutrons. The leukocytes were then separated and placed in short-term culture. Seventy-two hours later they were fixed, mounted and stained. The slides were scored for chromosomal aberrations. Unirradiated control slides showed the usual spontaneous frequency of cells with abnormal chromosome numbers and chromatid type aberrations. The irradiated cells yielded, in addition, the expected types of chromosome-type aberrations. The total yield of chromosome breaks increased as slightly more than the first power of dose. Rings and dicentrics increased approximately as the second power of dose. The coefficient of aberration production for chromosome deletions was 0.20×10^{-2} deletions/cell/rad while the coefficient of ring and dicentric production was 1.21×10^{-5} aberrations/cell/rad^2. Similar experiments with 250 kvp x rays (h. v. l. = 2 mm Cu) were performed in order to confirm that earlier measurements represented a true RBE of one by definition. When the 14-Mev neutron results were compared with the x ray results, the RBE for the neutrons was approximately two. Similar results with 2.5-Mev D, D neutrons are also discussed. In addition, estimates were made of fission-spectrum neutron RBE for chromosome aberrations in humans irradiated in a criticality accident. The results suggest that the RBE is approximately two in this case also. (auth)

38933 GENETIC EFFECTS OF NEUTRON IRRADIATION IN MICE. A. G. Searle and Rita J. S. Phillips (Medical Research Council, Radiobiological Research Unit, Harwell, Berks, Eng.). p.361-70 of "Biological Effects of Neutron and Proton Irradiations. Vol. I." Vienna, International Atomic Energy Agency, 1964.

The limited amount of information already published on this subject, mainly relating to the induction of dominant lethal mutations by fast neutrons at high intensity, is reviewed. Results are reported from studies on the genetic effects of fast neutrons at low intensity, using the reactor GLEEP. At a dose-rate of 0.01 rad/min, these fast fission neutrons are about six times as effective as acute x irradiation for the induction of dominant lethal mutations in spermatozoa. This value, and the linear dose-mutation relationship, are similar to previous findings with neutron irradiation at high intensity. The rate of induction of specific-locus mutations in mouse spermatogonia by about 215 rad of fast neutrons (with slight gamma contamination) and 650 rad of ^{60}Co gamma-rays, administered nearly continuously over twelve weeks, was studied. Results to date suggest that these neutrons are about 50 times as effective as gamma-rays for the induction of specific locus mutations; they would also appear to be about six times as effective as acute x irradiation. It is concluded that the type of dose-rate dependence associated with specific locus mutations induced by low LET radiations is most unlikely to occur with high LET ones; in fact it may be reversed. (auth)

38934 GENETIC EFFECTS OF PILE RADIATIONS IN RICE. H. Yamaguchi (Tokyo Univ.). p.371-82 of "Biological Effects of Neutron and Proton Irradiations. Vol. I." Vienna, International Atomic Energy Agency, 1964.

In attempts to utilize radiation-induced mutations for rice breeding, it is of primary interest to obtain fundamental data on the biological effects of mixed neutron γ radiations from reactors. Although considerable variation of radiosensitivity was found among rice varieties, Japanese rice was comparatively more susceptible to pile radiations than foreign varieties, and tetraploids were less susceptible as compared with the diploid varieties after irradiation. From the observation of the radiation injury of F_1 hybrids it was concluded that, in addition to the contribution of a gene or a gene system, the cytoplasm was related to the inter-varietal difference of radiosensitivity. Sterility was more easily induced by pile radiations than x irradiation. In the x-ray series, chlorophyll mutations on the X_1-ear basis reached a maximum frequency at middle doses and decreased at higher doses. In the pile radiation series the frequency increased with increasing doses. The cause of differences of these two series seemed to be a difference of the mean size of mutated sectors between both the radiations. The increment of induced variation on quantitative characters occurred in plus and minus direction with similar frequencies after the treatment of pile radiations. However, the heritable variations did not increase in accordance with neutron flux. The amount of induced variation was more in the progenies of partially sterile X_1 ear and less in those which segregated chlorophyll mutants in X_2 generation. It was calculated that 1 R of x and gamma rays was equivalent to 1 to 2×10^9 thermal neutrons per cm^2 for induction of chlorophyll mutations and of variation on quantitative characters. (auth)

38935 USE OF NEUTRON IRRADIATION IN AGRICULTURE AND APPLIED GENETICS. A. R. Gopal-Ayengar (Atomic Energy Establishment, Trombay, India) and M. S. Swaminathan. p.409-32 of "Biological Effects of Neutron and Proton Irradiations. Vol. I." Vienna, International Atomic Energy Agency, 1964.

By virtue of their relative insensitivity to the action of modifying factors, absence of secondary physiological effects associated with their action, and high RBE values for the induction of chromosome aberrations and mutations, neutrons have an important place in the array of mutagens available to the geneticist and plant breeder. Their superior usefulness for the induction of mutations in vegetatively propagated plants and in polyploids is clear. It is also evident from the available data that occasionally a different spectrum of mutations may occur in neutron experiments than that observed with x or gamma rays. The high survival rate of neutron-induced translocations presents possibilities in the production of specific duplications and deficiencies. Despite these helpful features, data on the usefulness of neutrons in applied genetical research are scanty. It is essential for a thorough understanding of the value of neutrons in applied research, that we have more data on the effects of a wide range of dosages of neutrons of varying energies and a wide range of treatment methods (such as combination treatments, different temperatures, boron enrichment, etc.) in the major crop plants. 165 references. (auth)

38936 COMBINED EFFECTS OF THERMAL NEUTRONS AND DIETHYL SULPHATE ON MUTATION FREQUENCY AND SPECTRUM IN RICE. N. S. Rao and A. R. Gopal-Ayengar (Atomic Energy Establishment, Trombay, India). p.383-91 of "Biological Effects of Neutron and Proton Irradiations. Vol. I." Vienna, International Atomic Energy Agency, 1964.

Treatment of rice seeds of variety Ptb-10 with 0.076 molar solution of diethyl sulfate drastically reduced the germination of seeds to 21% and the survival of plants to 13%. When seeds irradiated with thermal neutron doses of 5×10^{11} n_{th}/cm^2, 1×10^{12} n_{th}/cm^2, 5×10^{12} n_{th}/cm^2, and 1×10^{13} n_{th}/cm^2 were treated with 0.076 M solution of diethyl sulfate, there was an increase of germination and survival with increase in thermal neutron dose. There was a synergistic effect on mutation frequency in combined treatments of 5×10^{11} n_{th}/cm^2 and 1×10^{12} n_{th}/cm^2 and diethyl sulfate. The mutation frequency, however, decreased with higher doses of neutron and chemical treatments corresponding to survival. Better germination with combined treatments was obtained only when the seeds were treated with the chemical within 24 to 36 hr after irradiation. When irradiated seeds were stored for a week or more, no difference could be noted between chemical and combined treatments. Furthermore, low concentration (0.0456 M) and prolonged treatment (4 hr) also failed to show appreciable increase in germination. The better germination and survival with some combined treatments can possibly be due to physiological stimulation often noticed with neutron irradiation or due to the acceleration of hydrolysis and loss of efficiency of the chemical. The decrease in mutation frequency with better survival suggests loss of efficiency of the chemical due to rapid hydrolysis. (auth)

38937 RADIATSIONNYE EFFEKTY V BIOLOGICHESKIKH SREDAKH I ORGANIZMAKH I METODY IKH ISSLEDOVANIYA. (Investigations of Radiation Effects on Biological Media and Organisms). Ya. Kh. Turakulov, ed. Tashkent, Publishing House of the Sciences, 1964. 141p.

Twenty-three articles are presented on radiochemical transformations in amino acids and albumin and on effects of various nuclear radiations in biological media. Special

attention is given to the influence of nuclear emissions on cells and cell structures in animals and plants. Separate abstracts have been prepared for fifteen articles of special interest. (R.V.J.)

For abstracts of individual papers see: 38771, 38938, 38939, 38940, 38941, 38942, 38943, 38944, 39049, 39355, 39356, 39357, 39358, 39359, and 39415.

38938 HISTOLOGICAL STUDIES OF CERTAIN SUPRARENAL GLAND FERMENT FOLLOWING IRRADIATION. D. Kh. Khamidov, E. K. Shishova, and K. A. Zufarov (Lab. of Radiation Cytology, USSR). p.12-16 of "Radiatsionnye Effekty v Biologicheskikh Sredakh i Organizmakh i Metody ikh Issledovaniya." Tashkent, Publishing House of the Sciences, 1964. (In Russian)

Histochemical studies were made of suprarenal gland ferments irradiated with 400 R of ^{60}Co gamma rays. An analysis of 55 rats weighing 150 to 200 g killed at various times (1 to 5 months) after exposure showed a reduced cytochrome oxidase activity the first day after exposure. Two days after exposure the succinic dehydrogenase and cytochrome oxidase activities are increased in the suprarenal cortex and marrow substance. After 15 days the activity of ferments is especially reduced in the bundle and reticular regions, and after 20 days the activity of alkali phosphatase drops slowly and evenly in all places. A strong hypermia followed by degeneration of suprarenal cells begins on the sixth day after exposure to acute doses. (R.V.J.)

38939 HISTOCHEMICAL STUDIES OF NUCLEIC ACIDS IN TESTIS OF RATS EXPOSED TO NEUTRON AND γ IRRADIATION. A. K. Mirakhmedov (Lab. of Radiation Cytology, USSR). p.34-7 of "Radiatsionnye Effekty v Biologicheskikh Sredakh i Organizmakh i Metody ikh Issledovaniya." Tashkent, Publishing House of the Sciences, 1964. (In Russian)

Histochemical characteristics of nucleic acids in animal gonads were previously described, indicating that DNA is found in the form of grains and small clumps in the cell nucleus and that RNA appears in the cytoplasm and nucleole. The effects of neutron and γ irradiation on the DNA and RNA in the testis of rats were studied using 80 sexually mature rats weighing 150 to 220 g and exposed to 400 R of γ radiation at 33 R/sec or to 30 rads of thermal neutrons (2.8×10^7 n/cm^2 · sec) and 3.3 rads of resonance and fast neutrons. The results showed a decreased DNA and RNA content that paralleled the destruction of the sperm duct. Progressive destruction of the cell elements and reduced amounts of DNA and RNA were observed on the 14th and 60th days after exposure. On the 90th day after exposure the content of nucleic acids was restored to a normal level in some tubules. (R.V.J.)

38940 HISTOCHEMICAL STUDIES OF SUCCINIC DEHYDROGENASE AND CYTOCHROMOXIDASE IN THE TESTIS OF IRRADIATED RATS. A. K. Mirakhmedov (Lab. of Radiation Cytology, USSR). p.38-41 of "Radiatsionnye Effekty v Biologicheskikh Sredakh i Organizmakh i Metody ikh Issledovaniya." Tashkent, Publishing House of the Sciences, 1964. (In Russian)

Histochemical investigations of succinic dehydrogenase and cytochrome oxidase in the testis of rats were made using mature 150-g white rats exposed to 400 R of γ radiation at 33 R/sec and neutrons at 74 R/hr. The results confirmed published data that indicate an increase in ferment activity related to enhanced mutation processes. Degenerative processes in cells result in a drop in ferment activity. Thus, it is obvious that γ and neutron irradiation induce increased succinic dehydrogenase and cytochrome oxidase activities which act to protect the organism and reduce ferment activity. (R.V.J.)

38941 HISTOAUTORADIOGRAPHIC CYTOLOGICAL AND HISTOCHEMICAL STUDIES OF THYROID GLANDS DESTROYED BY RADIOACTIVE IODINE (^{131}I). K. A. Zufarov, D. Kh. Khamidov, and E. K. Shishova (Lab. of Radiation Cytology, USSR). p.49-58 of "Radiatsionnye Effekty v Biologicheskikh Sredakh i Organizmakh i Metody ikh Issledovaniya." Tashkent, Publishing House of the Sciences, 1964. (In Russian)

Histoautoradiographic, cytological, and histochemical studies of thyroid glands were carried out on 40 rabbits (weighing from 1100 to 1200 g) injected intraperitoneally with carrier-free ^{131}I (0.5 μC/g of body wt). The results showed that iodine, combined with thyroid globulin, appears in both colloid and apical cells, 15 to 30 sec after injection. Thyroidal follicles function simultaneously but with various intensities. Hence, follicles with higher iodine affinity are first to react to radioiodine damage. Radioiodine destroys the thyroid gland replacing it by connective tissue. Continuous damage does not affect the positive colloidal properties. (R.V.J.)

38942 CYTOLOGICAL ABERRATIONS IN MAIZE ROOTLET MERISTEMS OF GAMMA AND NEUTRON IRRADIATED SEEDS. S. A. Anastasov, B. N. Kulikov, and D. Saidalieva (Lab. of Radiation Biophysics, USSR). p.71-80 of "Radiatsionnye Effekty v Biologicheskikh Sredakh i Organizmakh i Metody ikh Issledovaniya." Tashkent, Publishing House of the Sciences, 1964. (In Russian)

Gamma irradiation of maize seeds with 500 R stimulated mitotic activity and increased kernel volume. Irradiation with larger doses (3,000 to 30,000 R) inhibited mitotic activity, increased the number of mitotic disorders and the volume of kernels, changed the ratio between kernel volume and cytoplasm, and reduced the amount of DNA in interphase kernels. Observations of plants that survived 10,000 and 30,000 R showed restoration of mitotic activity, diminished mitotic disorders, and an increased DNA content. Irradiation of seeds with neutrons (1.8×10^{12} n/cm^2) resulted in depressed mitotic activity and increased mitotic disorders. (R.V.J.)

38943 EFFECTS OF IRRADIATION PRIOR TO SOWING ON THE FREE AMINO ACIDS IN COTTON SEEDS. A. P. Ibragimov, Yu. A. Sil'vanovich, and A. Tulyaganov (Lab. of Radiation Chemistry, USSR). p.116-20 of "Radiatsionnye Effekty v Biologicheskikh Sredakh i Organizmakh i Metody ikh Issledovaniya." Tashkent, Publishing House of the Sciences, 1964. (In Russian)

Effects of γ radiation on nitric acid metabolism and amino acid content in water-soluble cotton seed proteins were studied using seed exposed to 500, 2,000, and 6,000 R. The results showed that in irradiated seed protein the amount of SH group is reduced. (R.V.J.)

38944 INVESTIGATION OF FREE RADICALS IN IRRADIATED COTTON SEEDS BY EPR METHOD. A. P. Ibragimov, A. Sultanov, A. Tulyaganov, and A. Dzhumanov (Lab. of Radiation Chemistry, USSR). p.128-30 of "Radiatsionnye Effekty v Biologicheskikh Sredakh i Organizmakh i Metody ikh Issledovaniya." Tashkent, Publishing House of the Sciences, 1964. (In Russian)

Investigation of cotton seed irradiated with 100 to 50,000 R showed that the reduction of radicals is faster in the seed lobe than in the skin. Tabulated data on seed

irradiated twice within a month with 25,000 R show 1.5×10^{15} and 6.5×10^{14} radicals/g for the skin and 5.75×10^{14} and 3.75×10^{14} for the seed lobe. Investigation showed that the sulfhydryl group begin to diminish following exposure to 100 R with a sharp (to 50%) reduction at 3,000 R. (R.V.J.)

38945 VOSSTANOVITEL'NYE PROTESSY PRI RADIATSIONNYKH PORAZHENIYAKH. Sbornik Statei Pod Redaktsiei Deistvitel'nykh Chlenov AMN CCCP. (Recovery Processes in Radiation Injuries. Meeting of the USSR Medical Academy of Sciences, Moscow, May 29-31, 1962). N. A. Kraevskii and A. V. Lebedinskii, eds. Moscow, Atomizdat, 1964. 244p.

Separate abstracts were prepared for each of the 32 papers on various aspects of recovery processes in radiation injuries. (M.G.)

For abstracts of individual papers see: 38946, 38947, 38948, 38949, 38950, 38951, 38952, 38953, 38954, 38955, 38956, 38957, 38958, 38959, 38960, 38961, 38962, 38963, 38964, 38965, 38966, 38967, 38968, 38969, 38970, 38971, 38972, 38973, 39019, 39020, 39021, and 39022.

38946 RECOVERY MECHANISM ON CELLULAR LEVEL. N. V. Luchnik, N. A. Poryadkova, L. S. Tsaraphin, and N. V. Timofeev-Resovskii. p.5-14 of "Vosstanovitel' nye Protessy pri Radiatsionnykh Porazheniyakh." Moscow, Atomizdat, 1964. (In Russian)

In studies on pea seeds and seedlings, time-effect curves showed the number of damaged cells, in the first mitosis, decreasing with time after doses of 10 and 15 kr γ radiation but increasing after a 20 kr dose. This indicates damage to the biochemical system rather than a differential radiation sensitivity of the cells. The effects of a series of substances in decreasing the number of chromosome mutations further indicated a biochemical recovery mechanism. Moisture had little or no effect on the results. The data presented are considered to be useful in evaluating irradiation damage and may indicate a means for decreasing genetic damage. 29 references. (IIC-M.G.)

38947 POST-RADIATION RECOVERY OF CELLS. V. I. Korogodin. p.15-22 of "Vosstanovitel'nye Protessy pri Radiatsionnykh Porazheniyakh." Moscow, Atomizdat, 1964. (In Russian)

In studies with yeast cells, survival immediately after a 70 krad dose of x radiation was 5%, which increased to a value of 60% after 25 hr incubation in a nutrient medium. The recovery is considered to be dependent on both the rate of the processes taking place and the proportion of recovering cells in the population. In colonies of irradiated cells incubated under favorable conditions, the ratio of potentially damaged individuals to those that did not form buds increased. But when the content of damaged cells was determined in relation to the budding cells, as the latter accumulated they lost the ability to recover. The survival of cells increased from 0.65 to 46% by changing both the concentration of the medium and the incubation temperature. (29 references) (IIC-M.G.)

38948 NEUTRON RADIATION EFFECTS ON THE MITOTIC ACTIVITY OF CORNEAL EPITHELIUM. V. M. Mastryukova and A. D. Strzhizhovskii. p.23-8 of "Vosstanovitel'nye Protessy pri Radiatsionnykh Porazheniyakh." Moscow, Atomizdat, 1964. (In Russian)

White mice were whole-body irradiated in a reactor to 50 or 200 rad. Immediately after the irradiation the corneal epithelium showed a complete cessation of cell mitosis. Abnormal mitosis reached a peak 4 to 5 days later. It was concluded that significant cell destruction in mice unrelated to damage to the mitotic apparatus would require a total roentgen irradiation of 700 rad. (IIC-M.G.)

38949 PROBLEMS IN MARROW TISSUE RECOVERY PROCESSES IN IRRADIATED ANIMALS. G. P. Gruzdev, M. I. Fedotova, and E. N. Shcherbova. p.29-34 of "Vosstanovitel'nye Protessy pri Radiatsionnykh Porazheniyakh." Moscow, Atomizdat, 1964. (In Russian)

Male rats were γ-irradiated (^{60}Co) to doses of 150 to 5000 R and the bone marrow was examined. Interference with the recovery processes was found to be largely due to damage to the function of cell division. Both rate and amount of division were affected. For small (150 R) and average (400 to 750 R) doses of radiation, the basic factor limiting recovery was interference with mitosis, which showed up as chromosome aberration. Such damage apparently does not show up in its ability to begin mitosis; in every case it was possible to predict the rate for cells without apparent damage as well as for cells with chromosome aberrations. According to the level of chromosome aberrations, damage to irradiated bone marrow cells from different species and in different stages of preparation for division is apparently similar. (tr-auth)

38950 EFFECTS OF CYTOPLASM ON THE RECOVERY OF CELLS FROM RADIOINDUCED GENETIC INJURIES. V. S. Barsukov, O. V. Malinovskii, and N. M. Mityushova. p.41-6 of "Vosstanovitel'nye Protessy pri Radiatsionnykh Porazheniyakh." Moscow, Atomizdat, 1964. (In Russian)

Recovery of genetically damaged irradiated yeast cells was according to the all-or-nothing law. Macrocytoplasmic structures took part in the process, and radiation damage to these decreased the possibility of recovery. An irradiated population of yeast cells may be described by a series of parameters that characterize the ability of the cells to recover. (tr-auth)

38951 RADIATION EFFECTS ON THE CELL DIVISION IN TISSUES OF VARIOUS RADIOSENSITIVITIES. M. G. Chumak. p.47-52 of "Vosstanovitel'nye Protessy pri Radiatsionnykh Porazheniyakh." Moscow, Atomizdat, 1964. (In Russian)

After whole-body exposure of mice to a 400 R dose of γ radiation, damage was observed to cell division processes in the corneal and intestinal epithelium, with subsequent recovery of the mitotic index after 72 to 96 hr and 48 hr, respectively. In the cornea all phases of the mitotic cycle were interrupted. In the intestine cell fragments able to prepare for division were retained. In both tissues recovery of DNA synthesis preceded restoration of a normal mitotic cycle. Comparison of results with literature data indicate that the radiation sensitivity of proliferating tissue depends inversely on the length of the mitotic cycle, while the rate of recovery of cells for division and the division itself depends directly on the length of the mitotic cycle. (tr-auth)

38952 CYTOCHEMICAL CHARACTERISTICS AND PROTECTIVE ACTIONS OF CELLS OF NERVOUS SYSTEM IN RADIATION INJURIES. A. L. Shabadash. p.53-60 of "Vosstanovitel'nye Protessy pri Radiatsionnykh Porazheniyakh." Moscow, Atomizdat, 1964. (In Russian)

An LD_{50}-LD_{75} irradiation of mammals caused an immediate change in the reaction of mitochondria of cells of the nervous system, as demonstrated by cytochemical studies of their ribonucleoprotein. The initial changes were physico-chemical which resulted in changes in the conditions for enzyme-substrate reactions in the cell. The

origin of inhibitory post-radiation conditions and the development of intracellular glycolysis and damages to the oxidation processes were accompanied by formation of mitochondrial chains. Their presence indicates a depression or restitution of physiological functions, and from the biochemical aspect indicates a decrease in oxidation and predominance of glycolysis. These factors are useful in diagnosis and analysis of radiation injuries. (tr-auth)

38953 ON RECOVERY PROCESSES IN ORGANS CONTAINING RADIOACTIVE ISOTOPES. V. N. Strel'tsova. p.61-9 of "Vosstanovitel'nye Protessy pri Radiatsionnykh Porazheniyakh." Moscow, Atomizdat, 1964. (In Russian)

Regeneration of liver parenchyma was studied in white rats that had been intraperitoneally injected with 0.6 μC of ^{144}Ce. By the end of the first month large cells with unusually large hyperchromic nuclei appeared in peripheral portions of the liver. With time these increased, and two or three months later they were found distributed in the parenchyma in all cases. After 120 days, when the radiation dose had decreased from 30 to 7 rads/day or lower, new parenchyma formed, showing some very small cells and a significant number of cells with two nuclei. Photomicrographs of tissues are shown. (IIC-M.G.)

38954 ON THE RECOVERY OF THE BRAIN AND SPINAL CORD SYNAPTIC STRUCTURES IN DOGS EXPOSED TO (600 AND 300 r) X RADIATION. A. G. Khanin. p.70-8 of "Vosstanovitel'nye Protessy pri Radiatsionnykh Porazheniyakh." Moscow, Atomizdat, 1964. (In Russian)

Morphological analysis of changes in the synaptic structures in the brain and spinal cord in radiation sickness of dogs indicated that these changes are toxicodystrophic processes. These include hypertrophy, polymorphism, deformation, breaks in the synaptic link, and disappearance of the synapsis. Changes were greater with a 600-R dose than with a 300-R dose. Microscopic examination showed that the snyaptic structures ending in the younger neurons were damaged more than those on the older. Axodendritic cells were damaged more than axosomatic. The endings apparently were restored when clinical recovery occurred. However, acute dystrophic changes remained, which were more noticeable for the higher (600 R) dose. The changes depended on the dose (300 or 600 R) and were more pronounced in the phase where clinical symptoms showed than in the clinical recovery phase. Recovery processes were more marked in less damaged structures. During clinical recovery not only restoration of the synaptic structures but compensating mechanisms occur. (tr-auth)

38955 COMPENSATORY RECOVERY PROCESSES IN CHRONIC ^{90}Sr-INDUCED INJURIES IN DOGS. D. I. Zakutinskii, L. N. Burykina, and E. N. Klimova. p.79-88 of "Vosstanovitel'nye Protessy pri Radiatsionnykh Porazheniyakh." Moscow, Atomizdat, 1964. (In Russian)

In 35 dogs fed 2×10^{-4} to 2×10^{-1} μC of ^{90}Sr per kg per day for up to 4 years, reflex responses, electrocardiographs, blood components, spermatogenesis, and pathological tissue changes were studied. The data obtained are considered important for clinical use in the prognosis of chronic radiation injuries. (IIC-M.G.)

38956 RESTORATION OF IMMUNOGENESIS IN IRRADIATED ANIMALS. N. N. Klemparskaya and G. A. Shal'nova. p.89-95 of "Vosstanovitel'nye Protessy pri Radiatsionnykh Porazheniyakh." Moscow, Atomizdat, 1964. (In Russian)

Recovery of immune reactions after irradiation and of the normal reaction to microbial antigens the mechanism of compensation, and the rate of the recovery processes are discussed. The author concludes that data now available indicate a need for further study of immunological reactions in irradiated organism. 15 references. (IIC-M.G.)

38957 ON THE RESTORATION OF RADIORESISTANCE IN THE ORGANS OF IRRADIATED MICE AND THE BEHAVIOR OF THE IRREVERSIBLE RADIATION INJURY. I. G. Akoev and M. A. Lagun. p.96-103 of "Vosstanovitel'nye Protessy pri Radiatsionnykh Porazheniyakh." Moscow, Atomizdat, 1964. (In Russian)

Decreased resistance of irradiated mice to Bac. perfringens toxin in lethal dose is related to irreversible radiation injuries. The decrease was observed after recovery of radiation resistance independently of the time of the irradiation and was cumulative in repeated irradiations. The appearance of these irreversible changes depends on the hormonal state of the animal, they occur in a state of hormonal (thyroid) insufficiency, and hormone therapy at the time decreases the changes. The irreversible changes in the recovered animal are shown either by the excessive demands on all systems of the organism or by chronic conditions resulting in a continuous strain on the compensatory mechanism. (tr-auth)

38958 PATHOGENESIS OF LATE RADIATION EFFECTS. S. N. Aleksandrov. p.104-9 of "Vosstanovitel'nye Protessy pri Radiatsionnykh Porazheniyakh." Moscow, Atomizdat, 1964. (In Russian)

Three types of radioinduced changes in animal cells discussed include incomplete loss of part or all of some cell types, damage restricted to the irradiated cells, and hereditary changes in the somatic cells. The work of numerous authors is reviewed, but sources are not cited. (IIC-M.G.)

38959 COMPENSATORY CHANGES IN THE FUNCTION OF KIDNEYS AND WATER-SALT METABOLISM IN DOGS SUFFERING FROM RADIATION SICKNESS INDUCED BY STRONTIUM-90. Z. I. Poluboyarinova. p.110-17 of "Vosstanovitel'nye Protessy pri Radiatsionnykh Porazheniyakh." Moscow, Atomizdat, 1964. (In Russian)

Female dogs given 2 μC of ^{90}Sr per kilogram by mouth were observed for about three years. In the resulting chronic radiation sickness, kidney function was damaged with respect to water-salt exchange. Kidney changes were of the tubular-canal type and developed slowly. Four to five months after the isotope was administered, kidney function approached normal, with a tendency to an increase in blood flow, tubular filtration, and secretory activity. With some variations, this state remained throughout the life of the animal (2 to 3 years). Morphological studies showed significant changes in the endocrine glands. (IIC-M.G.)

38960 RECOVERY OF THE GASTRIC SECRETORY FUNCTION FOLLOWING CHRONIC RADIATION. V. N. Zvorykin. p.118-28 of "Vosstanovitel'nye Protessy pri Radiatsionnykh Porazheniyakh." Moscow, Atomizdat, 1964. (In Russian)

Dogs were irradiated daily (5 R/day) for 2 to 5 months to total doses of 250, 250, and 600 R. At first, changes in the gastric secretion were very variable. When the irradiation was discontinued, the variations decreased during the next 3 to 5 months. Dogs irradiated to 250 R showed a period of hypersecretion with high acidity, that lasted 3 to 4 months. Recovery required at least 6 months, and in one dog was not complete even after 15 months. Hypersecretion was not observed with doses of 350 and 600 R. One of the 250-R dogs showed leukopenia. None of the dogs died. Data are tabulated for gastric juice on meat,

bread, and milk diets. The implications of the experimental results are discussed. (IIC-M.G.)

38961 ON THE RESTORATION OF THE FUNCTION OF HEMATOENCEPHALITIC BARRIER IN RADIATION SICKNESS. A. G. Kuzovkov. p.129-36 of "Vosstanovitel'nye Protessy pri Radiatsionnykh Porazheniyakh." Moscow, Atomizdat, 1964. (In Russian)

Dogs were subcutaneously injected with 10 μC of ^{32}P per kg and blood and fluid samples were examined. Within a few minutes an increased penetrability of the blood vessels of the brain and a higher nervous activity were noted. The penetrability remained high for several months. Recovery took place at different rates in the different animals. The data indicate a definite role of the nervous system in damage and recovery of the penetrability of the barrier following irradiation. (IIC-M.G.)

38962 PARTICIPATION OF THE BLOOD ACETYLCHOLINE–CHOLINE ESTERASE SYSTEM IN COMPENSATORY REACTION OF ORGANISM DURING RADIATION SICKNESS. N. E. Kuznetsova. p.137-47 of "Vosstanovitel'nye Protessy pri Radiatsionnykh Porazheniyakh." Moscow, Atomizdat, 1964. (In Russian)

Both the extent and the time of appearance of changes in the acetylcholine-choline esterase system of the blood of dogs after exposure to 300 and 600 R x irradiation varied with the radiation resistance of the animal. In the first hour after the irradiation the blood acetylcholine level was high and the choline esterase low, the changes being more rapid and more pronounced in dogs with the greater resistance. The high acetyl choline continued and was much more evident than the low esterase activity for the next 2 hr. A return to a comparatively normal clinical state occurred earlier in the dog with the greatest resistance, with the choline esterase activity becoming 1.5 to 2 times as high as the original level. In all dogs there was a second period of increased acetyl choline content and decreased choline esterase activity, and dogs with high resistance showed two or three such periods. In the terminal stages of the dogs irradiated to 600 R recovery did not occur. In the recovery stage of the dogs irradiated to 600 R, normal blood levels of the two substances were restored in 29 to 41 days. The studies indicate that the blood acetylcholine-choline esterase system plays a part in the compensatory reaction of the organism in radiation sickness. (tr-auth)

38963 REACTIONS OF THE HEMATOPOIETIC SYSTEM DURING RECOVERY FROM RADIATION INJURIES. I. M. Shur'yan, V. V. Andryushchenko, and G. M. Rekun. p.164-71 of "Vosstanovitel'nye Protessy pri Radiatsionnykh Porazheniyakh." Moscow, Atomizdat, 1964. (In Russian)

Male rabbits were used to study the effects of whole-body x irradiation to 860 R and of β irradiation from the intraperitoneal injection of 1.5 μC/kg of $Na_2H^{32}PO_4$. Both were $LD_{50/30}$ doses. In the ^{32}P-treated animals the peripheral blood began to recover slowly after 20 days, and was apparently normal after a year. Bone marrow recovery was similar, but very slow, in the four rabbits (of 14 treated) that survived one year. The peripheral blood of the x-rayed animals began to recover after 8 days and was normal after 3 months in the surviving animals. Bone marrow recovery began in 8 to 12 days and was apparently complete in 3 months. Electron microscope photographs are included which show the unusual nature of the changes in the cells at different times. (IIC-M.G.)

38964 IRREVERSIBLE CHANGES IN THE BLOOD PICTURE OF IRRADIATED ANIMALS. T. M. Kondrat'eva and V. G. Safronova. p.172-8 of "Vosstanovitel'nye Protessy pri Radiatsionnykh Porazheniyakh." Moscow, Atomizdat, 1964. (In Russian)

White rats were x irradiated to a dose of 500 R. Thirty percent died the first month. After 6, 12, and 15 months the numbers surviving were 50, 18, and 10%, respectively. All cell types in the peripheral blood showed changes. Reticulocyte levels increased from 2-fold higher than normal at 1 month to 4-fold at 15 months. The leukocyte level sharply decreased the first month, but after 3 months rose and went above that in the controls. However, the distribution of leukocyte forms was not normal. The number of abnormal cells was highest at 1 month, and was high again at 12 months, after some decrease. Abnormal nuclei were also seen. (IIC-M.G.)

38965 RESTORATION OF CLINICAL CHARACTERISTICS AND HEMATOPOIETIC SYSTEM IN DOGS FOLLOWING A REPEATED IRRADIATION BY γ RAYS. V. A. Rezontov, A. V. Popov, I. G. Akoev, P. S. Ponomarev, and O. O. Kaipa. p.179-86 of "Vosstanovitel'nye Protessy pri Radiatsionnykh Porazheniyakh." Moscow, Atomizdat, 1964. (In Russian)

One to 15 months after gamma (^{60}Co) irradiation of dogs to a minimum lethal dose, the reactivity of the organism decreased, as shown by a decrease in the recovery rate of clinical and hematological processes. The decrease in the restoration of myeolopoiesis after radiation sickness did not depend on the level of physiological regeneration of the blood-forming tissue at the time of irradiation. The restoration of myelopoiesis with time after irradiation may be reduced to an exponential or logarithmic mathematical model. By extrapolation it was calculated that the results of radiation damage could reduce the life span of dogs by 85 to 90%. (tr-auth)

38966 EARLY REACTIONS OF LEUKOCYTES DURING RECOVERY FROM RADIATION DAMAGE. I. K. Petrovich. p.192-6 of "Vosstanovitel'nye Protessy pri Radiatsionnykh Porazheniyakh." Moscow, Atomizdat, 1964. (In Russian)

Rats were x-irradiated with 50 to 12,000 R. Seven hours later the total leukocyte counts for those irradiated with doses of 1000 R and with 8000 R were 10 to 40% higher than those of the controls. In the 2000- and 4000-R rats the increase was 300 to 500%. Neutrophils began to increase at 40 min, reaching a maximum at around 6 hr of 1400% above normal for the 2000-R group and 300% for the 200 R, with other groups between these values. Lymphocyte counts fell immediately and were below control values for all except the 50-R group, which rose slightly at about 5 hr. (IIC-M.G.)

38967 POST-TRAUMATIC REGENERATION OF MESOTHELIUM DURING ACUTE RADIATION SICKNESS. V. P. Mikhailova and N. F. Maiorova. p.197-201 of "Vosstanovitel'nye Protessy pri Radiatsionnykh Porazheniyakh." Moscow, Atomizdat, 1964. (In Russian)

Rabbits were x irradiated to 1000 R, which is a higher dose than $LD_{50/30}$. Photomicrographs of mesothelial tissue sections showed mitoses within 2 or 3 days although many cells were abnormal. After 15 days there was a continuous mesothelial layer which contained numerous cells with 2 nuclei. It was concluded that mesothelium retains its ability to regenerate. (IIC-M.G.)

38968 DATA FROM HISTOCHEMICAL STUDY OF METABOLISM OF SUBSTANCES IN REGENERATIVE PROCESSES DURING IRRADIATION. N. N. Kurshakova and A. E. Ivanov. p.202-9 of "Vosstanovitel'nye Protessy pri Radiatsionnykh Porazheniyakh." Moscow, Atomizdat, 1964. (In Russian)

Lung tissue preparations from rabbits exposed to 800-R x radiation, and animals with lung tumors caused by intratracheal injections of 25 μC of colloidal ^{144}Ce were examined. Photomicrographs are presented, and the metabolic picture they present is discussed. It was concluded that many more such studies are needed especially long-term ones, for the classification of regeneration processes. (IIC-M.G.)

38969 REGENERATION OF AXOLOTL EXTREMITIES DEPRESSED BY X RAYS AND PREVENTION OF X-RAY INDUCED ULCERS. L. V. Polezhaev, N. A. Teplits, and S. Ya. Tuskova. p.210-16 of "Vosstanovitel'nye Protessy pri Radiatsionnykh Porazheniyakh." Moscow, Atomizdat, 1964. (In Russian)

Axolotl extremities damaged by x rays may be restored with RNA, protein, and homogenates of fresh, lyophilized, or even boiled tissues of rat organs in 90 to 100% of cases. With repeated excision of injured surfaces, injury continues to show and difficult-to-heal ulcers form. Administration of the mentioned substances and repeated excision prevents formation of the ulcers. The irradiation results in significant decrease in the RNA and DNA contents in the irradiated tissues and interferes with regeneration. These substances return to normal levels with the treatment. The decrease in regulative ability is apparently the result of damage to the biosynthesis of proteins and nucleoproteins, and recovery occurs when biosynthesis is restored. Treatment of the axolotl with RNA before a lethal-dose of radiation prolonged the life 37%. (tr-auth)

38970 DISTURBANCE OF REGENERATIVE HEALING PROCESSES IN THE ACUTE RADIATION-INDUCED SKIN NECROSIS. L. A. Afrikanova. p.217-24 of "Vosstanovitel'nye Protessy pri Radiatsionnykh Porazheniyakh." Moscow, Atomizdat, 1964. (In Russian)

In rats x irradiated to 5250 R, necrosis of the skin was evident by the second week. The course of the regenerative process was observed by noting the proportions and types of cells in histological sections made from 1 day to 1.5 years later. The results indicate that even after a mild radiation sickness the organism remains in an incomplete functional state for a long time as shown by the course of regenerative processes. (IIC-M.G.)

38971 REGENERATION OF SKIN AND INTESTINAL EPITHELIUM DURING A LOCAL AND WHOLE BODY IRRADIATION. K. M. Svetikova. p.225-30 of "Vosstanovitel'nye Protessy pri Radiatsionnykh Porazheniyakh." Moscow, Atomizdat, 1964. (In Russian)

Adult male white rats were burned immediately after local irradiation with doses of 1000 R or four days after a whole-body radiation dose of 800 R, which decreased the leukocytes from 15,000 to 1000 per cu mm of blood. In the controls, which were burned but not irradiated, a leukocytic swelling and other typical symptoms developed at the burned site the first day. In 7 to 10 days a large part of the wound was healed. Intestinal epithelium showed rapid degeneration but eventually was regenerated. In the irradiated rats mitotic activity stopped completely the first day and began again only on the second day with a large number of abnormal mitoses. The number gradually decreased during the first month. However, regeneration was similar to that in the controls. (IIC-M.G.)

38972 ACCELERATION OF POST-TRAUMATIC REGENERATION OF IRRADIATED MUSCLE DEVELOPING APLASTIC CONDITION. M. F. Popova. p.231-6 of "Vosstanovitel'nye Protessy pri Radiatsionnykh Porazheniyakh." Moscow, Atomizdat, 1964. (In Russian)

The effects of 2000 rads of x radiation on the regeneration of the gastrocnemius muscle of rats after surgical incision or mechanical injury were studied. Irradiation took place both before and after trauma. Results indicate that aplastic muscle tissue is more resistant to the effects of radiation than normal tissue. (C.H.)

38973 REGENERATIVE PROCESSES IN GASTROINTESTINAL TRACT AFFECTED BY SOME RADIOACTIVE SUBSTANCES. G. A. Lebedeva. p.237-42 of "Vosstanovitel'nye Protessy pri Radiatsionnykh Porazheniyakh." Moscow, Atomizdat, 1964. (In Russian)

^{144}Ce was given to white rats intra-gastrically at doses of 9 to 18 μC/g. Local damage to the gastrointestinal tract was considerable, and inflammation occurred. Damage was especially great in the small intestine, where the dose was small. Recovery was slow. By comparison, ^{210}Po is taken up principally by the reticulo-endothelial system and the decrease in the recovery process was evident only 5 to 8 months later. When ^{90}Sr was given, morphological damage to the gastrointestinal tract was not significant. Changes in the recovery process were seen only when prolonged damage was induced. (IIC-M.G.)

Radiation Effects Therapy and Countermeasures

38974 PLUTONIUM — SOME BIOLOGICAL NOTES. Arthur Lindenbaum. Argonne Natl. Lab. Rev., 1: No. 3, 3-5(July 1964).

The deposition and effects of Pu in animal tissues is discussed. The use of the synthetic chelating agent diethylenetriaminepentaacetic acid (DTPA) for the nonsurgical removal of Pu from body tissues is described. Its mode of action is considered to involve a successful competition with the body tissues for polyvalent Pu cations and the formation of a stable but soluble chelate in which the spatial relation between the DTPA and Pu moieties prevents polymerization before excretion can occur. Without treatment a small fraction of the Pu present in the circulation or tissues is excreted in the urine and feces due to tissue turnover and leaching by the natural chelating agents of the body, mainly citrate. With DTPA therapy, even if delayed, excretion can be accelerated, and more than one-half of the body burden of Pu can be removed. Some experiments are described. (P.C.H.)

38975 HOST CELL REACTIVATION OF GAMMA-RAYED T1. Walter Sauerbier (Universität, Cologne). Biochem. Biophys. Res. Commun., 17: 46-50(Sept. 1, 1964).

To test the hypothesis that host cell reactivating enzyme (HCR) acts as a versatile repair agent capable of eliminating various kinds of damage from DNA, the survival of γ-irradiated T1 was determined under conditions of HCR and when HCR was eliminated. Three methods used to prevent HCR were: parallel plating on indicator bacteria capable of performing HCR and incapable of HCR; inhibition of HCR by caffeine; and elimination of HCR by uv-irradia-

tion of the host bacteria. When γ-irradiated T1 was plated with indicator bacteria Escherichia coli, up to 22% of the lethal damage was repaired by HCR. Caffeine-supplemented media platings and the lowered survival in uv-irradiated hosts yielded further evidence for the repair of gamma-damaged DNA by HCR. It is concluded that repairable gamma and uv damages are different, but HCR is capable of repairing several types of DNA damage. (H.M.G.)

38976 HAEMATOPOIETIC CHIMERA IN MAN AFTER ALLOGENIC (HOMOLOGOUS) BONE-MARROW TRANSPLANTATION. (CONTROL OF THE SECONDARY SYNDROME. SPECIFIC TOLERANCE DUE TO THE CHIMERISM). G. Mathe (Hospital St. Louis, Paris), J. L. Amiel, L. Schwarzenberg, A. Cattan, and M. Schneider. Brit. Med. J., 2: 1633-5(Dec. 28, 1963).

A case is presented which represents the first example in a man of hematopoietic artificially-induced chimerism of long duration. It lasted longer, at least eight months, following a conditioning that had been no different from that which had made possible similar grafting in various species of animals. The patient, who had leukemia in the progressive phase, was subjected to 800 rads whole-body ^{60}Co γ irradiation, preceded by four days administration of methyl-nitroimidazolyl-mercaptopurine. Bone marrow from six donors was transfused. After eight months the patient's blood was completely repopulated with red cells which showed the antigenic characteristics of one of the donors. The patient also presented a specific tolerance for a skin graft from this donor. The results obtained confirm that allogenic bone-marrow grafting has its place among the methods of treatment of subjects exposed to radiation accidentally. (TCO)

38977 ANTIRADIATION EFFECTS OF LOW-MOLECULAR-VOLUME NARCOTICS. V. P. Paribok and G. F. Krupnova (Cytology Inst., Moscow). Farmakol. i Toksikol., 26: 737-42(1963). (In German)

Inert gases, hydrocarbons, freons, and other low-molecular narcotics tend to reduce the oxygen-conditioned radiosensitivity of the cell. The protective action becomes weaker with the increased molecular volume of the substance. A persorption hypothesis on the mechanism underlying antiradiation action of low-molecular narcotics is proposed: narcotics displace oxygen from narrow pores of radiosensitive biopolymers. (auth)

38978 PROTECTIVE EFFECT OF GALLATES AGAINST IRRADIATION WITH 1000 ROENTGENS. V. A. Baraboi (Bogomoletz Inst. of Physiology, Kiev). Fiziol. Zh., Akad. Nauk Ukr. RSR, 10: 89-93(1964). (In Ukrainian)

The efficacy of using gallates both before and after irradiation with a dose of 1000 R is established. The average lifetime of mice irradiated with a dose of 1000 R, equal to 5.6 ± 0.21 days in the control group, increases under the effect of defensive injection of propyl gallate and sodium gallate by 2.0 to 3.5 days, about 1.3 to 1.7 times. On administering these preparations immediately after radiation the lifetime of the mice increased on the average 2.4 to 2.6 days, by 50%. Defensive injection of cysteamine chlorhydrate (150 mg per kg of body weight) had no protective effect under the conditions of the experiments. (auth)

38979 RADIOSENSITIZATION OF STREPTOCOCCUS FAECALIS AND ESCHERICHIA COLI. Mohamed A. Noaman, Gerald J. Silverman, Norman S. Davis, and Samuel A. Goldblith (Massachusetts Inst. of Tech., Cambridge). J. Food Sci., 29: 80-6(1964).

The radiosensitizing activity of a series of naphthalene derivatives against Streptococcus faecalis and Escherichia coli was examined to determine the essential molecular substituents and configurations required for effective sensitization when the compounds and organisms were irradiated with ^{60}Co gamma rays. In general, compounds with hydroxyl or amino groups in the ortho and para positions, such as 1-amino-2-naphthol and 4-amino-1-naphthol, were particularly effective sensitizers for S. faecalis irradiated in air or in anoxia. E. coli was particularly sensitive to 4-amino-1-naphthol and 5-amino-1-naphthol when irradiated in anoxia, and less sensitive in air. Both organisms displayed marked sensitivity when irradiated with iodoacetic acid in air and in anoxia. It was determined that the bacteria and chemicals must be irradiated together for maximal radiosensitization to take place, for it was possible to almost eliminate radiosensitization by washing the cell-chemical suspension prior to irradiation. (auth)

38980 RADIATION SEQUELAE AND TREATMENT. Donald N. Anishanslin. J. Mississippi Med. Assoc., 4: 323-5(Aug. 1963).

Evidence for the carcinogenic action of ionizing radiations and sunlight in skin is briefly reviewed, and three cases are described and illustrated which showed cancerous or precancerous changes in skin as a result of excessive x or uv irradiation. The use of surgical dermabrasion to improve the cosmetic aspects of facial lesions is also described. The rate of recurrence of collagen degeneration and skin cancer appeared to be greatly diminished after dermabrasion, as seen on two- and four-yr followups on these patients. (BBB)

38981 THE EFFECT OF SPLEEN CELL SUSPENSION AND SPLENECTOMY ON LIVER REGENERATION IN RATS AFTER TOTAL-BODY IRRADIATION. Endre Czeizel, Gyoergy Vaczó, Kálmán Bolla, and Pál Kertai (Országos Közegészségügyi Intézet, Kórélettani Osztály, Budapest). Magy. Radiol., 14: 298-303(Sept. 1962). (In Hungarian)

Partial hepatectomy was performed on 180 rats to investigate the influence of injection of spleen cells on liver regeneration after whole-body irradiation. Some animals received whole-body x irradiation of 500 R 24 hr after the operation; other animals were subjected to splenectomy at the time of the partial hepatectomy; and some received a spleen cell suspension containing one-half of a spleen for each animal, injected intravenously and, sometimes intraperitoneally. One group of animals received a 500-R and 1000-R irradiated spleen cell suspension. The results indicate that spleen cell suspension tends to decrease the mortality due to irradiation, the same effect being similarly achieved by splenectomy. The irradiated spleen cell suspension had no protective effects. Spleen cell suspension appeared to abolish the inhibitory effect of irradiation on liver regeneration; removal of the spleen tended to have the same effect. The spleen cell suspension apparently minimizes the lethal effects of irradiation and the damage to the hemopoietic system, and also counteracts the effect it has on cell multiplication. The irradiated spleen suspension loses this ability. There is no apparent connection between liver regeneration and the spleen, but the spleen is postulated to contain two factors, one a protective one and the other a toxic one. The protective factor is activated from an unknown substance by irradiation; the irradiated spleen is thought to release the toxic factor which hinders liver regeneration; when the spleen is removed the lack of this toxic factor allows increased liver regeneration. (BBB)

38982 TREATMENT OF GENERALIZED AND LOCAL RADIATION REACTIONS. K. H. Kaercher (Universität, Heidelberg). Med. Monatsschr., 17: 351-4(June 1963). (In German)

Methods for treating radiation sickness are evaluated. The electrolyte disturbances and protein defects that appear after whole-body irradiation can be improved by infusion of electrolytes and amino acids. Symptoms, such as nausea, anorexia, diarrhea, hypotonia, and dizziness, also disappear with this treatment. Therapy with coenzyme components or substrates, such as vitamins, flavinoids, nicotinamide, and pyridoxine, improve the enzyme deficiency that follows exposure to radiation. The depression of leukocytes or other blood components is also retarded. Doses of glucocorticoids used for treatment of generalized radiation reactions should be as high as 80 to 100 mg each, but this can be reduced as the treatment progresses. It is questionable whether this treatment is justified for reduction of radiation effects on the mucosa or skin, because such high doses are required that complications or side-effects can easily be produced. Other substances may be helpful, including mixtures of rutin, combined with vitamins A and C, that have a protective effect against radiation in the areas of the neck, nose, and ears, or the mucosa of the pharynx and esophagus. However, the treatment must be initiated at the beginning of the radiation exposure, and the vitamins should be given at very high dosages. The results of this therapy are as effective as administration of 50 to 100 mg of prednisone. Naturally, the radiation reaction is not entirely prevented, but the symptoms are so reduced that nutritional impairment is largely avoided. There is no late reaction to the radiation when this treatment is stopped as there is when prednisone treatment is stopped. This is one of the main arguments against use of steroid therapy in the course of radiation treatment of mucosal tumors. Also, animal experiments have shown that steroid treatment favors spread of metastases, although it has a cytostatic effect on the tumors themselves. (BBB)

38983 ON THE PATHOPHYSIOLOGY AND THERAPY OF THE REACTION OF THE SKIN TO RADIATION. K. H. Kaercher (Universität, Heidelberg). Med. Welt, No. 3, 151-3(Jan. 19, 1963). (In German)

Histochemical skin studies show that irradiation increases the acid mucopolysaccharide and glycogen concentrations in the epidermis in the stratum spinosum and germinativum, resulting from an inhibition of glycolytic energy metabolism. These are reversible changes, but leave radiation scars that are morphologically proportional to the radiation dose. There is also degranulation of the mast cells, which is the reason for the excessive concentrations of acid mucopolysaccharides. The mast cells react to irradiation by release of heparin, histamine, chondroitin sulfate, serotonin, and other amines. These products have a great effect on connective tissue metabolism in the formation of ground substance. Enzyme studies show that the glycolytic and cyclophorase enzymes decrease markedly after radiation, but their activities are normal after reepithelization. The nonspecific esterases also behave in this way. Alkaline phosphatase is localized in the hair follicle capillaries and sweat glands, but it is not detectable in skin except after irradiation when it is found in the area of inflammation and at the borders. It disappears when the inflammation subsides. The healing effects of salves on the reaction of the skin to radiation increase linearly with increasing fat content, and for powders, it is least. This is because salve, by preventing heat loss, increases skin metabolism, while powder has a cooling effect. For this reason powder should be used for dry skin, but when there is exudation, salves are best. The best combination for exudative therapy is a wet linen bandage (2% boric acid) over a thin layer of emulsified oil-water salve. Secondary infection may be controlled by a 2% aqueous gentian violet solution. It is not necessary to incorporate drugs such as steroids, antihistamines, pantothenic acid, vitamins, etc, into the salve because these may have untoward reactions. Infrared or uv light may increase the inflammation and pain. (BBB)

38984 ON THE THERAPY OF X-RAY ULCERS WITH ACTIHAEMYL. E. Gaebel and O. Paul (Strahleninstitut der Allgemeinen Ortskrankenkasse, Cologne). Muench. Med. Wochschr., 103: 1377-9(July 14, 1961). (In German)

A protein-free extract of calf blood, Actihaemyl, that has high reticuloendothelial activity, and produces accelerated wound healing, is very useful in treatment of ulcerations of various geneses resistant to therapy. The preparation is free of antigens and pyrogens, and is well tolerated. As shown by its LD_{50} in mice, it is essentially nontoxic when administered intravenously. The preparation stimulates connective tissue activity, and increases oxidative metabolic activity even in tissues with decreased oxygen supply. Its healing properties favor formation of granulation tissue, and pain in the region of the lesion is reduced. It is available as a salve or as a jelly. (TCO)

38985 MECHANISMS OF SENSITIZATION TO X-RAYS OF MAMMALIAN CELLS BY 5-BROMODEOXYURIDINE. J. T. Lett, G. Parkins, and P. Alexander (Royal Cancer Hospital, London). Nature, 203: 593-6(Aug. 8, 1964).

Whether the sensitizing action of 5-bromodeoxyuridine (BUDR) is due to enhancement of radioinduced scission on the main DNA chain at the phosphate-ester bond by introduction of a bromine atom or to interference in repair of radiochemical damage sustained by DNA was investigated by determining radiochemical damage in normal and 5-bromouracil (BU)-containing DNA and by comparing the degree of sensitization that can be obtained with BUDR in mutants that differ in radiosensitivity because they vary in capacity to undergo post-irradiation repair. Results indicate that BU did not increase the extent of main-chain scission when the DNA was irradiated in situ under conditions where the cells (Escherichia coli B/r) were more radiosensitive or when isolated DNA was irradiated. Yet to account for the radiosensitization of cells on a purely radiochemical basis, it would be necessary to postulate that damage to BU had a much greater probability of being lethal than damage to other bases. It is proposed that radioinduced cell death is determined by two distinct types of primary radiochemical lesions: damage to the critical structure, and the interference with some of the metabolic systems which are responsible for repairing the critical structure. (H.M.G.)

38986 OXYGEN AS A RADIOTHERAPEUTIC ADJUVANT. Peter Wootton (Swedish Hospital, Seattle). Progr. Radiation Therapy, 2: 94-113(1962).

Fundamental aspects of the influence of O on tumor cell radiosensitivity and its use to enhance destruction of tumor cells in radiotherapy are reviewed. Also discussed are theories of the O effect, which are numerous and none cover all observations. Problems encountered in exposing patients to high O tensions prior to irradiation are enumerated and possible solutions offered. From the results obtained it appears that the predictions from radiobiological experiments are borne out in clinical practice. (OTS)

38987 EFFECTS OF AET ON MUTATIONS INDUCED IN MICE BY X RAYS. I. EFFECTS ON IRRADIATED SPERMATOZOA. A. Leonard and J. R. Maisin (Centre d'Etude de Energie Nucleaire, Mol, Belg.). Rev. Franc. Etudes Clin. Biol., 8: 923-6(1963). (BLG-240). (In French)

AET does not increase the number of latent dominant induced mutants in non-irradiated mouse spermatozoa. On the other hand it does not diminish these mutants in mouse spermatozoa irradiated with 400 R. (auth)

38988 THYMECTOMY: EFFECT ON SECONDARY DISEASE IN RADIATION CHIMERAS. L. M. van Putten (Radiobiological Institute TNO, Rijswijk, Netherlands). Science, 145: 935-6(Aug. 28, 1964).

The pattern of secondary mortality in mice after irradiation and hemopoietic cell transplantation was changed by thymectomy of the recipients 3 weeks before irradiation. In isologous and parent-to-F_1 chimeras excess mortality was occurring later than the usual period of secondary disease. In thymectomized heterologous chimeras secondary mortality was decreased and delayed. (auth)

38989 RELATION BETWEEN THE CATALASE ACTIVITY OF YEAST AND ITS SUSCEPTIBILITY TO RADIATION DAMAGE. Yuan Chen Chin and Chen-Lu Chou (Academy of Sciences, Peking). Sheng Wu Hua Hsueh Yu Shing Wu Wu Li Hsueh Pao, 3: 460-5(1963). (In Chinese)

It was found that the susceptibility to x radiation of yeast cells was not appreciably affected by aeration. Inhibition of the catalase activity of yeast cells with hydroxylamine during x-irradiation did not increase the percentage of dead cells produced. Apparently, there is no correlation between the catalase activity and the susceptibility to radiation damage of yeast cells. (auth)

38990 CONTRIBUTION TO THE TREATMENT OF RADIODERMATITIS. H. Mertens (Nachbehandlungskrankenhaus fur Geschwulstkrankheiten, Bad Muender, Ger.). Z. Haut Geschlectskrankh., 30: 115-18(Feb. 1961). (In German)

The treatment of severe radiodermatitis is primarily symptomatic, and also is designed to protect against infections until the skin recovers. Synthetic azulene acid is effective in reducing inflammation and promoting reepithelialization. It appears to induce capillary hyperemia, increase phagocytosis, and reduce formation of histamine in cells. In combination with B vitamins, arnica, chamomile, chlorophyll, and other substances, the action of the compound is reinforced, with rapid decrease in pain and sensation of tension in the irradiated area. The skin dries quickly and shows epithelialization without exudate. Recovery time ranges from 17 to 26 days, but the pain subsides within one day. There are no contraindications against its use. Of all the cases treated with this salve only seven had secondary infections, with only two abcesses. Administration of antibiotics or sulfonamides was not required. The deodorant properties of this salve were demonstrated with two exophytic, irradiated head tumors. (BBB)

38991 KHIMICHESKAYA PROFILAKTIKA RADIATSIONNYKH PORAZHENII. (Chemical Prophylaxis of Radiation Injuries). A. S. Mozzhukhin and F. Yu. Rachinskii. Moscow, Gosatomizdat, 1964. 244p.

Chemical changes resulting from ionization and excitation of irradiated media, chemical protection of organic systems from the effects of ionizing radiation, properties of radioprotective substances and methods of their evaluation, mechanisms of the biological effects of ionizing radiation, chemical protection of biological objects from the effects of x and γ radiation, chemical prophylaxis of acute radiation sickness, behavior of radioprotective sulfur-containing compounds in organisms of higher animals and man, the effect of radioprotective preparations on the functional condition of higher animals and man, and possible mechanisms of protective effects of agents for the chemical prophylaxis of radiation injuries are discussed. Numerous references are included. (C.E.S.)

38992 ENERGY SPECTRA OF ATMOSPHERIC γ-RAYS AT BALLOON ALTITUDE AND OF γ-RAYS FROM INTERACTIONS IN GRAPHITE. P. K, Malhotra, P. G. Shukla, S. A. Stephens, and B. Vijayalakshmi (Tata Inst. of Fundamental Research, Bombay). p.232-9 of "International Conference on Cosmic Rays. Vol. 5." Bombay, Tata Inst. of Fundamental Research, 1964.

An emulsion-tungsten sandwich assembly surrounded by 1-inch thick graphite was exposed at an effective depth of 22 g/cm^2 for 28 hr over Hyderabad, India. Preliminary results are presented from work done on events initiated in the sandwich assembly by the electromagnetic component entering from outside and on families of cascades resulting from the nuclear interactions in the graphite. So far 34 events attributed to nuclear interactions in graphite have been analyzed. The combined energy spectrum of the γ rays from these events, energy distribution of γ rays in a few individual events, and energy spectra of 130 atmospheric cascades are shown. The average number of γ rays of energy above 50 Bev observed for each event was 5.1. A brief comparison of results with theory leads to the conclusion that the observations reported can be explained on the basis of the production of isobars of masses 2-3 Bev. (A.G.W.)

Radiation Hazards and Protection

Refer also to abstract 39472.

38993 (HW-SA-3693) THE SIGNIFICANCE OF RADIONUCLIDE CONTAMINATION IN RUMINANTS. L. K. Bustad, R. O. McClellan, and R. J. Garner (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). [Aug. 24, 1964]. Contract AT(45-1)-1350. 34p. (CONF-667-1)

From 2nd International Symposium on the Physiology of Digestion in the Ruminant, Ames, Iowa, Aug. 1964.

Ruminants may become contaminated by radionuclides released by nuclear detonations and to a much more limited extent by nuclear industry operations or by reactor accidents. Although over 200 radionuclides may be released, only a few are of biological significance. The fission products selected for discussion are ^{90}Sr as a bone-seeking radionuclide and a source for β irradiation of skin; ^{131}I as a source of thyroid radiation; ^{137}Cs as a representative gamma emitter and a source of whole body irradiation; and ^{144}Ce, a poorly absorbed element, as a source of β irradiation for the gastrointestinal tract and γ-irradiation of the whole body. The data presented regarding damaging doses and amounts secreted in milk show the economic value of ruminants would not be affected by fallout radionuclides until the level of contamination of ^{90}Sr, ^{131}I, and ^{137}Cs are manifold greater than that which would give concern from the point of view of the health of meat-eating and milk-drinking people. 61 references. (auth)

38994 RADIATION HAZARDS AND MANNED SPACE FLIGHT. J. Hazel (Royal Victoria Hospital, Montreal). Aerospace Med., 35: 436-9(May 1964).

The three major components contributing to the radiation present above the earth's atmosphere in free space are outlined and estimates on dosage levels in each of the areas are given. The biological assessment of the radiation is discussed in general terms and the lack of specific data as to dosage rates and biological effects pointed out. The problems of tolerance and recovery for chronic exposures to radiation over longer periods of time, as conceivable in space flight, are approached on the basis of clinical situations where total-body radiation is given on a fractionated basis, information available from fallout studies, and exposures accepted by radiological workers. It is pointed out that the uncertainties and unknowns in the situation at present far outweigh the facts that can be stated with certainty. Lifetime total-body exposures of up to 400 r of penetrating radiation for early space explorers and up to 200 r for future space passengers have been suggested as compatible with a reasonable risk of late somatic injury in the present state of knowledge. (auth)

38995 EXPERIMENTAL STUDIES ON THE PROBLEM OF MEDICAL RADIATION PROTECTION OF CORNEAL TISSUE. W. Muenich. Ber. Deut. Ophthalmol. Ges., 64: 280-2(1961). (In German)

The effect of SH-containing compounds in blocking enzymes is postulated to be the basis of radiation protection by these compounds; accordingly, administration of 2,3-dithiolpropanol (Sulfactin) was carried out to determine changes in the incorporation of ^{35}S-sulfate in the acid mucopolysaccharides of the cornea in the rabbit after irradiation (^{90}Sr). Two series of experiments were carried out. Eight rabbits were irradiated (1000 R) in the right eye; the left served as control. After 8 hr 1.5 mC ^{35}S-sulfate was injected intravenously, and the animals were sacrificed 80 hr later. The activity of the ash from the dialyzed corneal homogenate was determined. In the second series ten rabbits were administered 2.5 mg Sulfactin/kg body wt for 5 days intravenously. The irradiation was carried out on the second day, and the experiment then proceeded as in the first. It was thus found that without previous treatment with Sulfactin, the percent incorporation of ^{35}S-sulfate in the ester sulfate fraction decreased from the control by 19.9%. With the administration of Sulfactin, this decrease from the control value was only 1.5%. Thus 2,3-dithiolpropanol greatly reduces the loss in incorporation due to β irradiation of the eye. Other protective thiols (cysteine, cysteamine) have not yet been investigated in this regard. (BBB)

38996 MASS CASUALTIES IN THE CIVILIAN HOSPITAL. James H. Spencer (American Coll. of Surgeons, Chicago). Bull. Am. Coll. Surgeons, 48: 342-4(Nov.-Dec. 1963).

The organization of hospital resources and personnel to care for a large number of casualties to be expected after a thermonuclear attack or other emergency situation is discussed. (BBB)

38997 RADIATION DOSE TO THE SKIN AND TO THE GONADS FROM DIAGNOSTIC X-RAY PROCEDURES. H. E. Duggan and G. L. Olde (Univ. of Alberta Hospital, Edmonton, Can.). Can. Med. Assoc. J., 89: 1144-7(Nov. 30, 1963).

A study was made to assess the hazard to patients from radiation received during diagnostic radiological procedures. A simulated body phantom of refined paraffin wax was used so that the central axis entrance and exit doses and total gonadal dose could be measured. Dose values for 10 different mid-section thicknesses were determined for appropriate kilovoltages for anteroposterior, lateral, and posteroanterior sections, including 12 basic radiological positions. To circumvent differences between the different x-ray units used, complete sets of measurements were made for each unit. Although the differences generally were not as great as was expected, this provided a highly individualistic reading for each patient. Most of the variations encountered were caused by different styles of collimating devices. It was found that the actual kilovoltage used for a particular patient thickness and for a particular radiologic view varied considerably. As a result it was necessary to prepare charts of correction factors for adjustment of doses measured at a particular kilovoltage to actual doses received at the kilovoltage employed. These charts were based on the relative x-ray output of the units over the kilovoltage range involved. Gonadal, entrance, and exit doses, reproducible and accurate to about 10%, could be calculated for each film taken with one of the six x-ray units used, by making use of these various tables of values. Phase two entailed the tabulation and recording of information on the individual patient. The hospital requisitions on all patients receiving a significant gonadal dose were examined. From this information the dose values for the phantom could be located for the same radiologic view, for the same patient thickness, for the same x-ray unit, and presumably for the same technique. Any difference in technique can be corrected by making use of the kv correction charts and the direct relation between dose, milliamperage, and time. Based on some measurements made on actual patients, it is estimated that the doses so calculated are representative of the actual dose received by a particular patient to within 20%. All this material was then punched on two specially designed IBM cards. These cards enabled automatic computation of the actual absorbed doses and the selection of individuals according to, for example, the total gonadal dose received over a certain period of time. Data were collected for ~20,000 patients on about 80,000 dosage cards. The families of individuals receiving x-ray examinations in their reproductive years will be followed up for some clue to the presence or absence of increased abnormalities. (BBB)

38998 CARCINOMA OF THE CERVIX IN THE THIRD TRIMESTER OF PREGNANCY. Arthur B. Hunt and Richard E. Symmonds (Mayo Clinic, Rochester, Minn.). Clin. Obstet. Gynecol., 6: 964-74(Dec. 1963).

The hazards to the fetus from the use of irradiation, from Ra or external sources, to treat cervical cancer are assessed with reference to observed cases and those reported in the literature. The importance of establishing the diagnosis during early pregnancy is emphasized. The hazards of this form of therapy are considered too great and it is concluded that in cases of cancer of the cervix in the third trimester of pregnancy, the pregnancy should be terminated by cesarean section as soon as the diagnosis is made. (TCO)

38999 RADIATION PROTECTION IN A RADIUM ROOM. E. C. Lork (Frauenklinik der Medizinischen Akademie, Magdeburg, Ger.). Deut. Gesundheitsw., 16: 2167-70(Nov. 16, 1961). (In German)

Measures taken to reduce exposure of medical personnel handling radium when photometric controls showed that the radiation exposure of such persons was disproportionately high are described. (TCO)

39000 ON THE IMPROVEMENT OF PROTECTING DEVICES OF THE ROENTGENOSCOPIC TABLE, THE DISTRIBUTION OF SCATTERED RADIATION, AND THE DOSAGE OF RADIATION RECEIVED. Takashi Iwa, Tomotsu Hirata, Toshiaki Arinami, Yoshihiko Kubo, and Mitsuo Nakama (Second Hokkaido National Sanatorium, Sapporo). Iryo (Tokyo), 15: 511-20(July 1961). (In Japanese)

Measurements were made of the distribution of scattered radiation and the radiation dose received by exposed portions of radiologists and the nurses assisting them, before and after improvements were made in the protecting devices of the radiologic department. A ratemeter was used for assessing the scattered radiation, and pocket dosimeter and film badge for the subjects' exposure. During radiodiagnosis before improvements were made, a large amount of scattered radiation was recorded; in some places more than 1000 mR/hr dose rates were reached near the position of the radiologist and the nurses assisting him. After the improvements were made, scattered radiation decreased markedly. A considerable amount of leakage was measured around the x-ray tube housing, and near the tube there were zones which presented up to 500 mR/hr rates. In some places there was scattered radiation from the roentgenoscopic table, but the patients were protected by some metal parts of the table. After the improvements were instituted the radiation dosage received by radiologists and nurses decreased about 10%. It is pointed out that even after protective measures are put into effect, constant vigilance is required to see that they are consistently practiced. (BBB)

39001 RADIATION HAZARDS ASSOCIATED WITH THE USE OF MOBILE IMAGE INTENSIFIER X-RAY MACHINES. B. D. P. Williamson (Dominion X-ray and Radium Lab., Christchurch, New Zealand). J. Coll. Radiologists Australasia, 4: 117-24(Dec. 1960).

Tests were made on two Muller BV-20 image-intensifier x-ray machines to see whether any undue radiation hazards existed and recommendations are made regarding their safe use. The tests and the results obtained are discussed together with the associated recommendations made by the Dominion X-ray and Radium Laboratory. Further recommendations for average maximum operating times are made in the table form. (TCO)

39002 GAMMA IRRADIATION OF BACILLUS SUBTILIS SPORES IN THE PRESENCE OF SUGARS. A. M. Cook, T. A. Roberts, and Jean P. Widdowson (Univ. of London). J. Gen. Microbiol., 34: 185-93(Feb. 1964).

Freeze-drying from 5% glucose solution was previously shown to have a significant protective effect on B. subtilis spores subsequently subjected to γ irradiation. This work was extended to include maltose and fructose, and the results with glucose and lactose confirmed, by using tube dilution and plate count methods. (C.H.)

39003 RADIATION PROTECTION IN X RADIOGRAPHY OF THE HIP JOINT IN SMALL CHILDREN. Hans Hofer and F. Kainberger (Chirurgische Abteilung (Othopaedische Station) der Landeskrankenanstalten, Salzburg, Austria). Klin. Med. (Vienna), 17: 377-84(June 1962). (In German)

There is general agreement that it is relatively simple to protect the male gonads against radiation exposure, but in females of all ages it is much more difficult. In newborn female infants the ovaries have a wide range of possible movement, which is lost with increasing age as the ovaries become displaced caudally. The age when this occurs is rather variable. A knowledge of the location of the ovaries is necessary for reasonably appropriate protection against radiation exposure with a suitable Pb plate or apron with the proper Pb absorption equivalent. In female children and adults shielding of the symphysis and the lower half of the pelvis is useless. The oval shaped shield so often used is not wide enough and does not extend far enough cranially to afford proper protection, because it shields only the uterus. Studies with several shield forms have shown that a triangular shield fixed at the symphysis and the spina iliaca anterior superior gave very adequate protection. In order to ensure that a shield with this configuration would be retained in place when used with active infants, the Pb sheet is positioned and held by a steel spring affixed to the sheet that extends around the trunk of the infant. Two sizes of this type of gonadal shield have been used: one for infants up to the age of 8 months, and a larger one for infants and children 9 months of age or older. For male infants and children an attachment was provided so that a testicular shield could be attached. The effectiveness of these shields has been demonstrated by photographic tests. Although it was not possible to confirm the results by means of direct measurements with an ionization chamber, there was no evidence of photographic darkening of the films by exposure to either direct or scattered x radiation when the Pb shield was used. With this shield the final radiation dosage is without a doubt much too small to cause somatic damage. (BBB)

39004 DECAY PRODUCTS OF RADIUM IN CERAMICS AND THEIR INTERACTION WITH MATTER. A. F. Gabrysh, H. Erying, O. H. Bezirjian, and J. M. Merrill (Univ. of Utah, Salt Lake City). Mater. Res. Std., 3: 902-5(Nov. 1963).

The significance of Rn leakage from common ceramic household materials is discussed, and analyses presented of samples of air taken from homes containing many ceramic ornaments showing a Rn concentration two to three orders of magnitude higher than in air outside the building. The concentration of Rn in the outside air ranged from 2×10^{-12} to 7×10^{-12} $\mu C/cm^3$. Parallel studies of air were taken, over the same period, from inside two homes which contained many glazed figurines, ceramic products, and imported vases. These gave values ranging from 3×10^{-10} to 12×10^{-10} $\mu C/cm^3$. These increases pose a serious health problem to inhabitants when added to already existing concentrations in homes built of materials containing more than about 0.003% U, as shown in an earlier study. Radon concentrations of about 1.5×10^{-7} $\mu C/cm^3$ of air could exist because of the building material itself. Inhaled radioactive particles emanating from ceramic housewares may be retained in the lungs or redistributed to other organs of the body. These minute deposits of radioactive substances, particularly α emitters, may cause a variety of disorders in humans. If these α emitters are redistributed from the lungs, they tend to be deposited in the bone, and their toxicological action resembles that of Ra. The relative buildup of the Rn daughter products Ra A, Ra B, and Ra C deposited by room air sucked through filter paper is also given. The primary hazard from breathing air containing Rn is from these daughters, of which about 25% are normally retained in the respiratory system. (BBB)

39005 INCORPORATION OF FALL-OUT STRONTIUM-90 IN DECIDUOUS INCISORS AND FOETAL BONE. Harold L. Rosenthal, Shirley Austin, Sheila O'Neill, Kunisuke Takeuchi, John T. Bird, and John E. Gilster (Washington Univ., St. Louis). Nature, 203: 615-16(Aug. 8, 1964).

Samples of non-carious deciduous incisor teeth of children born between 1950 and 1958 within a 150 mi radius of St. Louis were pooled and analyzed for ^{90}Sr. The value of the ^{90}Sr concentration of deciduous incisor teeth as a

measure of ^{90}Sr body burden and the relation of the body burden to the dietary mild concentration for bottle-fed children at the time the teeth are formed were demonstrated. Differences between the values obtained for bottle-fed and breast-fed children were within the analytical error of the estimates and did not interfere seriously with the usefulness of tooth ^{90}Sr as an index of ^{90}Sr body burden. (H.M.G.)

39006 RADIATION EXPOSURE FROM RADIOISOTOPES IN PEDIATRICS. Ronald A. Seltzer, James G. Kereiakes, and Eugene L. Saenger (Univ. of Cincinnati). New Engl. J. Med., 271: 84-90(July 9, 1964).

Doses sustained by children from the diagnostic use of radionuclides are calculated for the most commonly employed methods in use. A short description of the metabolism of each compound and radionuclide is given, together with the reasons for its use and the assumptions necessary in specific cases. Methods of calculation of whole-body and organ doses (β and γ) are described in detail. Data are provided for the following nuclides: ^{55}Fe, ^{59}Fe, ^{51}Cr, ^{57}Co, ^{58}Co, ^{60}Co, ^{32}P, ^{198}Au, ^{203}Hg, ^{125}I, ^{131}I, and ^{132}I. In addition to these nuclides, doses received from tests employing compounds containing the isotopes are also shown. Also included in the tables for comparison are doses sustained during selected radiographic procedures. The results show that an infant or child may sustain an average whole-body dose from a given quantity of a radionuclide up to 20 times that sustained by an adult because the smaller mass allows for less dilution of a given quantity of radioactive material. Their clinical uses of this factor in dose reduction are discussed. (TCO)

39007 CURRENT DATA ON THE RISK OF MEDICAL RADIOLOGY FOR THE EMBRYO, THE FETUS, AND THE CHILD. REPORT ON MEASURES ALREADY TAKEN IN VIEW OF THE FORMER WARNING. SUGGESTIONS ON FUTURE MEASURES. M. Tubiana, M. Mayer, J. Lejeune, J. de Grouchy, and O. Rethore. Pediatrie, 18: 463-70 (1963). (In French)

Surveys concerned with the danger inherent in irradiation of the fetus, the newly born, and the infant are reviewed. Malformations and leukemia resulting from in utero irradiation are considered. It is suggested that systematic radioscopic and fluoroscopic examinations be abolished, being used only under precise medical indication. Measures for reducing the danger of overexposure from radiography are presented. (H.M.G.)

39008 STUDIES ON THE EFFECTS OF CHEMICAL PROTECTIVE COMPOUNDS IN MICE AT LOW RADIATION DOSE RATES. Howard L. Andrews (National Institutes of Health, Bethesda, Md.), Dorothy C. Peterson, and David P. Jacobus. Radiation Res., 23: 13-18(Sept. 1964).

Mercaptoethylamine or 2-aminoethylthiosulfuric acid was provided in the drinking water of mice exposed to γ-rays from ^{60}Co with drug concentrations adjusted to maximize drug intake without producing chemical toxicity. Radiation dose rates ranged from 1 to 5 R/hr with essentially continuous irradiation until death. No protective action was observed with either compound. (auth)

39009 GONADAL EXPOSURE IN DIAGNOSTIC AND THERAPEUTIC X-RAY PRACTICE SHOWN BY PHANTOM MEASUREMENTS. I. Nikl (Railway Hospital and Central Polyclinic, Budapest). Radiol. Diagn., 2: 111-21(Aug. 1961). (In German)

Factors influencing gonaldal exposure during radiotherapy and radiodiagnosis that are discussed are: placement of shielding; sex of the subject; the type of photograph made (posterior-anterior vs. anterior-posterior); and the type of diagnostic procedure used (x ray vs. fluoroscope).

39010 A PROPOS OF THE COMPARATIVE DOSIMETRY IN RADIOPHOTOGRAPHY AND FLUOROSCOPY. J. Remy (Université, Paris). Rev. Tuberc. (Paris), 27: 466-70(Apr. 1963). (In French)

A compariative study of two methods made from the clinical point of view in 369 cases of tuberculosis showed that fluoroscopy revealed 69% of the active cases and radiophotography identified 90%. The mean duration of a fluoroscopic examination was determined with eight fluoroscopists and two instruments. Six studies on 1000 patients each were run; the times of exposure varied from 22.2 sec for normal subjects to 28.4 sec for suspected cases. The duration depended on the mechanical state of the instrument, regulation of tube settings and diaphragm, psychologic state of the operator, and appearance of a suspected image. The mean time necessary for fluoroscopy was 23 sec. The ratios of gonadal doses at equal kv values under defined conditions for radiography, radiophotography, and fluoroscopy were found to be 1 : 3.5 : 6.5 (theoretical : 1 : 4 : 8), using 200 subjects. Judicious choice of tube settings, filter, film, and developer permitted a decrease of values by nearly 40%. The dose in radiography (at 110 kv, 5 ma, 170 cm focus, 2 mm Al) was 35 to 55 mr; that for radiophotography (110 kv, 6 ma, 105 cm focus, 2 mm Al) was 120 to 180 mr. It is concluded that correctly applied radiophotography results in lower patient exposure than conventional fluoroscopy and remains the method of choice in systematic detection of pulmonary diseases. (BBB)

39011 RADIATION PROTECTION IN USE OF RADIUM AND OTHER ENCLOSED GAMMA RADIATION CELLS. Werner Schlungbaum (Roentgenabteilung des Staedtischen Krankenhauses, Berlin). Roentgen-Lab. Praxis, 15: R105-10(June 1962). (In German)

The great risk with use of radioactive materials and the difficulties of providing adequate radiation protection is based on several factors. Unlike x-ray equipment their radiation cannot be turned off. The radiating substance can produce changes in its own storage site, and the radiation emitted is much more energetic and harder than the usual x radiation. For Ra and ^{60}Co the half value layer of Pb is ~1 cm. For these reasons special protective measures are necessary even when the radioactive source is not used, and must be suited to the particular environmental conditions encountered. It is not possible to protect personnel who use enclosed gamma sources by the usual protective clothing used with x-ray installations. Adequate protection against radiation from enclosed gamma sources, consisting of a reduction of the dose to acceptable values, can be accomplished by increasing the distance from the radiation source, decreasing the exposure time by speeding up the series of work operations or even fractionating the work into separate units, and by use of protective devices, such as shields around working areas or remotely operated handling devices. The greatest emphasis should be placed on increasing the working distance with an enclosed source, because this is a much easier way to provide adequate protection than use of shielding materials. This is because the dose factor decreases in accordance with the inverse square law. For example, the radiation from a ^{60}Co source can be reduced by 75% by doubling the source distance. It would require 2 half value layers of Pb to accomplish this by shielding. However, radiation protection equipment is indispensable. Monitoring should include accurate measurement of the source intensity in the

working areas where radioactive substances are used and in adjacent spaces. (BBB)

39012 MEASUREMENT OF PERSONAL IONIZING RADIATION DOSE IN POLAND IN 1960–1961. T. Musialowicz and J. Wysopolski (Central Laboratory for Radiological Protection, Warsaw). Symp. Tech. Zagadnien Ochrony Promieniowaniem, Warsaw, 63-84(1962). (In Polish)

The methods used by the Central Laboratory for Radiation Protection for personnel dose monitoring are described. The results of the systematic personnel dose determinations by film blackening methods for persons working with radioactive materials are given. In the year 1960 approximately 22,000 determinations (on an average 845 determinations in a monitoring period) on about 1500 workers in 61 operations and in 1961 about 20,000 determinations (on an average 1665 in one monitoring period) on about 2400 workers in 79 operations were carried out. The results were dependent on the type of operation and were analyzed on the basis of the age and sex of the personnel monitored. People working with radiation (gynecologists, medical orderlies, and technical personnel in luminescent paint industries) often had radiation injuries. (tr-auth)

39013 MEASUREMENT OF X AND GAMMA RADIATION EXPERIMENT DOSES IN 1960-1961 IN LABORATORIES USING CLOSED RADIATION SOURCES. J. Domanus and M. Wolski (Electrotechnical Inst., Industrial Radiology Establishment, Warsaw). Symp. Tech. Zagadnien Ochrony Promieniowaniem, Warsaw, 85-95(1962). (In Polish)

The Institut für Electrotechnik has conducted for some years personnel and site monitoring around radiation sources in laboratories using sealed radiation sources. In previous years these measurements included both industrial operations and hospitals. In 1960, 21,405 personnel monitorings were carried out, comprising 2783 persons in 368 radiological installations. In 1961 there were 6436 monitorings on 677 persons in 67 installations. The personal doses were measured with film dosimeters. The results were compiled for monthly and yearly periods. The values of personal doses were tabulated separately for scientific, industrial, and medical installations. Site measurements were periodically carried out. Measurements were carried out at 22 installations in 1960 and at 61 in 1961. (tr-auth)

39014 INDIRECT METHODS OF DETERMINATION OF SOIL CONTAMINATION FROM ALL KINDS OF PRECIPITATION. H. Golinczak and J. Stasiuk. Symp. Tech. Zagadnien Ochrony Promieniowaniem, Warsaw, 179-85 (1962). (In Polish)

An indirect method based on the determination of the ^{90}Sr concentration in bones is used to indicate the soil contamination occurring as a result of nuclear weapon testing. The contamination modifications occurring over a period of time were investigated by determination of the ^{90}Sr concentration in the deer horn from different years. The deer lose their antlers yearly and in the formation of these horns they use large amounts of Ca with which ^{90}Sr is also deposited. The ^{90}Sr concentration in the horns corresponds to the amount of radioactive fall-out in the given year. By means of chemical analyses, ^{90}Sr and ^{90}Y were separated. The activity of individual samples was measured and the concentration of $^{90}Sr/g$ Ca was determined according to the year from which the horns came. (tr-auth)

39015 RADIATION EXPOSURE AND RADIATION PROTECTION OF THE GONADS IN UROLOGICAL X-RAY DIAGNOSIS. R. Ueberall (Urologische Abteilung des Kaiser Franz Josef-Spitals, Vienna). Urol. Intern., 13: 230-5(1962). (In German)

The gonadal shielding used during urography is described. It consists of plates, hoods, and capsules constructed from 3-mm thick Pb. The capsule completely encloses the scrotum, and is available in two sizes. It can be almost completely closed. The plate and hood has a replaceable, washable surface, and can be disinfected. For photography of men from the dorsal aspect the hood is used. It provides almost complete protection from direct radiation, and more than 50% protection from scattered radiation. For example, in a normal intravenous pyelography with four photographs ~30 mr exposure has been recorded when this type of shielding is used. For children, young men, and men when lateral or abdominal views are made, the capsule is used. The dose to the protected gonads is reduced by this means to 1 or 2% of the incident dose. Protection of the female gonads requires individual provision of protective shields. In intravenous urography these shields make it possible to reduce the exposure of the ovaries to less than half of the dose received when the ovaries are unshielded. (BBB)

39016 ON THE PROBLEM OF RADIATION PROTECTION IN MEDICINE. E. G. Mayer (Universität, Vienna). Wien. Klin. Wochschr., 74: 645-8(Sept. 28, 1962). (In German)

Studies of the radiation exposure of medical personnel were made in accordance with the precepts established in the publications of the International Commission for Radiation Protection. These studies have produced the following results. Less than 3% of the maximum permissible dose was recorded for 88% of the personnel, 7.5% of the personnel received between 3 and 30% of the permissible dose, 4.5% of the personnel received between 30 and 100% of the permissible dose, and none of the medical personnel received a radiation dose that exceeded the permissible limit. The highest personal exposures were found with those who worked with sealed radioactive sources. However, since this type of radiation therapy is being replaced more and more by high-voltage therapy and by close-up radiation sources, exposure from handling of small radioactive sources can be expected to diminish. (TCO)

39017 SEVERAL RADIATION PROTECTION MEASURES FOR X-RAY STUDIES. K.-H. Michalk (Chirurgische Universitätsklinik, Rostock, Ger.). Z. Aerztl. Fortbild., 55: 119-25(Feb. 1, 1961). (In German)

Measures considered for reducing somatic and genetic injury resulting from diagnostic x-ray studies are: adequate training of radiologists and associated personnel; elimination of needless x ray; avoidance of repetitious x-ray studies; proper timing of radiodiagnosis in women; and exposure control using film badges and dosimeters, aluminum filters, a well-directed beam, shielding, and efficient physical arrangement of the therapy room. Methods for dose reduction during fluoroscopy are also discussed. (TCO)

39018 REDUCTION OF SKIN INJURY FROM TELECOBALT THERAPY BY A MAGNETIC FIELD. F. Schwabe, R. Fischer, and W. Ahlendorf (Friedrich-Schiller Universität, Jena, Ger.). Z. Aerztl. Fortbild., 55: 640(May 15, 1961). (In German)

An apparatus with a magnetic field strength sufficient to divert electrons of 1-Mev energy from the body surface reduced skin exposure. Diversion of the electrons away from the area was demonstrated by x-ray film studies.

This was also demonstrated by the apparatus in telecobalt therapy. Although the initial tests are not entirely completed, comparison of the skin reaction in the same body fields in the same patients show that skin damage is less when the magnetic field apparatus is used with telecobalt therapy. (TCO)

39019 COUNTERACTING RADIATION INJURIES BY TRANSPLANTATION OF HEMOPOIETIC TISSUE AND PERSPECTIVES OF THE METHOD IN RADIOBIOLOGY. R. V. Petrov and Yu. M. Zaretskaya. p.35-40 of "Vosstanovitel'nye Protessy pri Radiatsionnykh Porazheniyakh." Moscow, Atomizdat, 1964. (In Russian)

In the field of radiation protection, a model of a radiation chimera indicates the possibility of differentiating the direct effect of a radioprotective agent on the cell from its pharmacological action on the whole organism. The irradiation of cells and the action of a protective factor were observed in vitro, and the results of quantitative and functional effects of the damage and protection were considered. The problem of postradiation recovery has not been studied sufficiently on the cell level. Work has been done on yeast which shows basic patterns of recovery of cytoplasmic and nuclear damage. However, these patterns and the practical conclusions cannot be applied to mammalian cells. Such studies on a model of a radiation chimera in culture would be very promising. In the field of radiation immunology and immunology in general, questions of damage to and recovery of antibody formation processes, cessation and stimulation of this function by other agents, etc. could be solved at the cell level. (tr-auth)

39020 THE INFLUENCE OF CERTAIN MEDIATING SUBSTANCES ON THE BLOOD SYSTEM DURING IONIZING IRRADIATION. N. V. Traskunova. p.148-55 of "Vosstanovitel'nye Protessy pri Radiatsionnykh Porazheniyakh." Moscow, Atomizdat, 1964. (In Russian)

In rabbits x irradiated to 600 R, the thrombocyte level decreased to 25% of normal on the 12th day but returned to normal by the 20th day and then went a little higher. In animals subcutaneously injected with 10 mg/kg of diphacil per day for 3 days and then irradiated, the level rose to 150% of normal on the 3rd day and dropped to near normal on day 30. In the controls the megakaryocytes completely disappeared from the bone marrow by the 3rd day but not until the 7th day in the experimental animals. In both groups the megakaryocytes began to recover by the 15th day. Several courses of injections of diphacil to healthy rabbits strongly stimulated bone marrow myelopoiesis and the thrombocyte level in the peripheral blood increased and remained high for 30 to 40 days. In irradiated animals the thrombocyte level was high for 7 days but dropped on the 12th. When 8 courses of injections were given, the thrombocyte level rose after each. The results indicate that diphacil acts through the central nervous system to stimulate the hypophysis. (IIC-M.G.)

39021 AUTOTRANSPLANTATION OF MARROW CELLS DURING THE THERAPY OF RADIATION SICKNESS INDUCED BY EXPERIMENTAL SINGLE AND FRACTIONAL IRRADIATION. G. S. Strelin and N. K. Shmidt. p.156-63 of "Vosstanovitel'nye Protessy pri Radiatsionnykh Porazheniyakh." Moscow, Atomizdat, 1964. (In Russian)

In 350 adult male white rats, the effects of whole-body x irradiation with no screening, and the protective effects of a lead screen on the femur region, and screen plus introduction into the blood stream of bone marrow taken immediately after irradiation from the screened bone of the same animal were evaluated. The dose was 650 R in the first part of the experiment and to a total of 1050 R in the second. All unscreened animals died within 15 days of the screened, 18% survived, and in those given the marrow recovery began in 6 to 7 days and 48% survived. Changes in cell types with time are shown graphically. (IIC-M.G.)

39022 EFFECTS OF CYSTAMINE ON RECOVERY PROCESSES DURING IRRADIATION WITH VARIOUS POWER AND DOSAGE. A. S. Mozzhukhin, E. N. Antipenko, O. K. Makhalova, E. G. Mikhailova, L. M. Pavlova, and L. I. Tank. p.187-91 of "Vosstanovitel'nye Protessy pri Radiatsionnykh Porazheniyakh." Moscow, Atomizdat, 1964. (In Russian)

Administration of cystamine to mice a short time before x or γ (^{60}Co) irradiation increased the survival rate. Data obtained in a series of experiments indicated that cystamine acts differently in different processes and tissues, and probably stimulates recovery of those functions that are essential to life. The mechanism of radiation damage is not the same for different doses and dose rates. ^{35}S cystamine, 1 hr after administration, was found chiefly in the radiosensitive organs, especially the intestine bone marrow and spleen. (IIC-M.G.)

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Refer also to abstract 39416.

39023 (AEC-tr-6390(p.540-4)) PRODUCTION OF PREPARATIONS WITH RADIOISOTOPES FOR RADIOTHERAPY. V. I. Levin and N. G. Serebryakov. Translated from Tr. Tashkentsk. Konf. po Mirnomu Ispol'z. At. Energii, Akad. Nauk Uz. SSR, 2: 407-?(1960).

The preparation of tracers for use in radiotherapy is discussed. Methods of producing colloid solutions of radioactive gold, silver, or zirconyl phosphate are described and the physicochemical properties of the colloids formed are outlined. (M.C.G.)

39024 PREPARATION OF ^{85}Kr-CONTAINING PHYSIOLOGICAL SODIUM CHLORIDE SOLUTION. H. Schaefer and G. Vormum (Institut fur Angewandte Isotopenforschung, Deutsche Akademie der Wissenschaften, Berlin). Acta Biol. Med. Ger., 12: 511-16(1964). (In German)

Some theoretical and practical aspects of the preparation of isotonic ^{85}Kr saline solution and its application in diagnosis of cardiac shunt are examined. The solubility of Kr in water obeys Henry's law, and the addition of an electrolyte lowers its solubility. Solubility of Kr in H_2O at various temperatures in tabulated and the ratio of volume of gas to volume of solution is plotted vs temperature. Experiments to determine the solubility of ^{85}Kr in isotonic saline solution indicate a mean decrease in solubility from that in pure water of 5.3% at 20 ± 1°C. Studies were made of the loss of ^{85}Kr from solution resulting from decreasing partial pressure of Kr: losses amounted to as much as 4.7% in 2 hr. Total losses of activity of solutions in ampoules were 14.1% and 12.6%, compared to theoretical values of 84% and 97.4% for different partial pressures respectively; experimental values are tabulated for β activity of solutions measured with a liquid scintillation counter. The loss of activity by leakage from the ampoules was also examined; only minor losses during the sealing-off process were noted. Where solutions had been concentrated greatly,

there was greater loss during the closure of the ampoule. Representative experiments are tabulated for these determinations. Commercial 2-ml ampoules filled to 2.3 ± 0.1 ml with 0.63 ± 0.10 ml gas above the liquid have 82% of total activity in the gas and 18% in the solution. Maximum deviation from the quantity of ^{85}Kr dissolved within the limits of error determined above is ±20%. (BBB)

39025 INDIVIDUALLY DESIGNED FILTERS IN COBALT 60 TELETHERAPY. Lennart Sundbom (Inst. of Radiophysics, Stockholm). Acta Radiol., 2: 189-208 (June 1964).

The author discusses a method of applying ^{60}Co γ-radiation with compensators to adjust for irregular body contours, and with individual filters mounted at a distance of 20 cm or more from the patient to modify the standard dose distributions. The accuracy attained in these cases is treated theoretically and compared to experimental values. (auth)

39026 IMAGE CONTRAST AND INTEGRAL DOSE. Carl Carlsson (Lund Univ., Sweden). Acta Radiol., 2: 219-25(June 1964).

The relation between integral dose and image contrast was determined from contrast measurements during diagnostic radiographic examinations. Variations of the different physical parameters to obtain an acceptable contrast level at the lowest possible integral dose are discussed. A high voltage and a heavy grid are recommended for radiography of thick body parts, and a low voltage and no grid for radiography of thin body parts. (auth)

39027 AN OUTLINE OF THE USE OF RADIOISOTOPE TECHNIQUES IN MEDICAL DIAGNOSIS. Henry N. Wagner, Jr. (Johns Hopkins Medical Institutions, Baltimore). Am. J. Med. Sci., 247: 601-32(May 1964).

An extensive review is presented, emphasizing the advantages of the use of radioisotopes in clinical diagnosis, the nuclear physical principles involved, and the hazards attendant to the use of radioisotopes. Selected techniques employing specific isotopes are outlined, and specific examples are illustrated. (C.H.)

39028 ISOTOPES IN THE CLINIC FOR HEART DISEASES AND FOR CANCER. ISOTOPE-ANGIOCARDIOGRAPHY WITH THE GAMMA-RETINA. W. Fucks, H. W. Knipping, E. Liese, and G. Schumacher (Technische Hochschule, Aachen; Universitat, Cologne; and Institut fur Medizin der Kernforschungsanlage, Julich, Ger.). Atomkernenergie, 9: 271-8(July-Aug. 1964). (In German)

The gamma-retina is an instrument to visualize the distributation of radioactivity especially in biological materials. In comparison with other instruments it yields better time resolution. Thus time dependant processes, e.g., the motion of blood or the agitation of heart or lungs, can be made directly visible or recorded with a camera. Two types of the apparatus are described. The results of some experiments in isotope-angiocardiography on models and on intact organisms are presented. With the help of the retina, bronchial cancer could be diagnosed. (auth)

39029 LEUKEMIA AND MALIGNANT TUMOR IN THE SAME PATIENT. M. Faber and Kirstine Borum (Finsenlaboratoriet, Copenhagen). Brit. J. Haematol., 8: 313-20 (Oct. 1962).

A survey was made of the known cases of leukemia in Denmark from 1942 to 1954 to investigate its relation to previous radiation exposure and to the incidence of associated malignant disease. In 9 of the 485 cases with acute leukemia there was a history of previous malignant disease. Seven of the 362 cases with chronic myeloid leukemia also had malignant disease, in all but two preceding the onset of the leukemia. Malignant disease was found 26 times in 760 cases of chronic lymphatic leukemia, but only five times preceding the diagnosis. The greater incidence of malignant disease in the course of chronic lymphatic leukemia could not be fully accounted for by the age distribution and the duration of this form of leukemia. The 14 patients with previous malignant disease who subsequently developed acute leukemia or chronic myeloid leukemia had all received radiation treatment for the malignant state but only four of the five cases of chronic lymphatic leukemia had done so. These results support the generally held concept that ionizing radiation is a factor in the origin of certain cases of acute leukemia and chronic myeloid leukemia but not of chronic lymphatic leukemia. An attempt was made to estimate the latent period between irradiation and the development of leukemia. The longest latent period so estimated for chronic myeloid leukemia was ~140 months and that for acute leukemia ~60 months. The latter, however, does not agree very well with the latent period observed in the patients who had had a previous malignant tumor. Most of the patients in the total leukemia group had been irradiated for rheumatic disorders of various kinds. There is the possibility that these disorders by themselves give rise to a different degree of x-ray sensitivity. This could account for any difference in the apparent latent period in the patients with previous malignant disease as compared with all the cases previously treated with x rays who developed leukemia. Such a difference was found in the patients with acute leukemia where half had a latent period longer than the calculated 60 months. No explanation was offered for this discrepancy and it is suggested that a larger group of patients is required to solve the question. It is pointed out that the latent periods after x-ray treatment for benign gynecologic diseases also showed the same pattern and only the patients who later developed acute leukemia exhibited an unexpected long latent period. (BBB)

39030 THYROTOXICOSIS TREATED BY SURGERY OR IODINE-131. WITH SPECIAL REFERENCE TO DEVELOPMENT OF HYPOTHYROIDISM. M. Green and G. M. Wilson (Univ. of Sheffield, Eng.). Brit. Med. J., 1: 1005-10(Apr. 18, 1964).

Attempts are made to evaluate the untoward effects of ^{131}I treatment of hyperthyroidism by surveying results in a large number of patients, especially the induction of hypothyroidism. After partial thyroidectomy for thyrotoxicosis the incidence of hypothyroidism rose slowly to about 6% after 10 yr. The condition was more likely to appear in patients showing positive autoimmune reactions. In contrast, after ^{131}I therapy there was a much steeper linear rise in the incidence of hypothyroidism with the passage of time, reaching 29% after 10 yr and showing indication of a plateau. Liability to develop hypothyroidism after ^{131}I therapy could not be predicted by autoimmune reactions. Use of a lower initial ^{131}I dose followed by antithyroid drug therapy reduced injuries significantly. (TCO)

39031 EUSTACHIAN TUBE OBSTRUCTION AND RADIATION THERAPY. H. E. Duggan and D. L. Weijer (Univ. of Alberta Hospital, Edmonton, Can.). Can. Med. Assoc. J., 90: 1454-6(June 27, 1964).

The use of x radiation is reported in the treatment of 194 patients with eustachian tube obstruction due to hypertrophied lymphoid tissue. Radiation therapy administered once a week for four weeks, for a total dose to the skin for each

lateral port of 600 r, and midline dose for a skull of 12 cm width of ~42 rad for every 100 R on the skin. Of 121 patients under 15 years of age, 70% were completely better or markedly improved at six months; 8% showed no change. Long-term follow-up, averaging four and a half years after therapy, indicated that 82% were completely better or markedly improved and 8% were unchanged. Of 73 patients over 15 years of age, 58% were completely better or markedly improved at six months and 20% showed no change. After long-term follow-up (four years and four months after treatment), 58% were completely better or markedly improved and 17% showed no change. It is concluded that external radiation therapy is of marked benefit in the treatment of conductive deafness caused by hyperplasia of lymphoid tissue obstructing the eustachian tubes. The results of treatment in people under 15 yr of age are better than in those who are more than 15 yr old. (BBB)

39032 TRITIUM, A NEW RADIOACTIVE THERAPY FOR THE TREATMENT OF RECURRENT MALIGNANCY (A PRELIMINARY REPORT). Donald C. Collins. J. Appl. Nutr., 16: 226-8(1963).

The characteristics, advantages, and therapeutic results with a new ^{3}H-labeled compound are presented. Since 2-methyl-1,4-naphthaquinol (Synkavit) is an effective radiosensitizer that concentrates selectively in certain human and animal malignant tumors, it was labeled with ^{3}H. With three firmly adherent T atoms per molecule it has a specific activity of about 85 C/mmole and one C is present in 4.88 mg of the compound. The T is incorporated within this compound by reductive dehalogenation of the corresponding tribromo derivative, 2-methyl-5,6,7-tribromo-1,4-naphthaquinol, employing carrier-free T in the presence of a specific catalyst. Twenty-nine patients, who had advanced or recurrent malignant diseases that failed to respond to the more conventional forms of antitumor treatment, were treated by intra-arterial injection of this substance. Temporary improvement, as evidenced by symptomatic betterment and reduction of the need of analgesics, was seen in 20 persons (69.6%). Types of malignancy for which use of the compound is most successful are listed. (OTS)

39033 SOME UNUSUAL COMPLICATIONS OF CARCINOMA OF THE CERVIX AND THEIR TREATMENT: THREE CASE REPORTS. Charles H. Wright and Eli M. Isaacs. J. Natl. Med. Assoc., 55: 529-31(Nov. 1963).

Possible complications resulting from radiotherapy for cervical cancer are enumerated, and their symptoms, diagnosis, and treatment are described with reference to a case which exemplifies radiation side-effects. A 23-yr-old woman with invasive (Stage 1) cervical carcinoma received 2500 mg-hr of Ra followed by 2800 mg-hr three weeks later. Deep x-ray therapy was given before and after the first Ra insertion. Urologic studies showed right hydronephrosis with narrowing of the right ureter. The bladder mucosa presented may hyperplastic plaques with mucosal hemorrhages. A survey of similar cases shows that urologic complications after radiation therapy for carcinoma of the cervix causes considerable postirradiation morbidity. These experiences support the need for a routine x-ray evaluation of the postirradiation patient's urologic system three to six months after the end of therapy. (OTS)

39034 INTRACAVITARY IRRADIATION OF MALIGNANT BRAIN TUMOURS. C. G. Drake, P. M. Pfalzner, and E. A. Linell (Univ. of Western Ontario, London, Can. and Univ. of Toronto). J. Neurosurg., 20: 428-34(1963).

Massive gamma radiation was directed to the bed of the tumor in nine patients with malignant gliomas using the isotopes ^{192}Ir and ^{137}Cs in special applicators. Useful life was not prolonged except in one patient who has now survived for eight years without recurrence. In three cases it was possible to destroy the deeply placed residual tumor, at a price, however, of a degree of necrosis from radiation that ended the patients' lives in much the same fashion as recurrence of tumor. It is believed that the reason for viable tumor cells remaining in these three cases was the result of failure to irradiate tumor-containing dura mater overlying the shielding of the applicator. (auth)

39035 ATRIOVENTRICULAR DISSOCIATION IN A CASE OF RETICULOSARCOMATOSIS AND THE EFFECTS OF STEROID AND ^{60}Co IRRADIATION. Kohji Tamura, Yohji Aoki, Akihiko Kawabe, Tadashi Mashima, and Chutaro Oguro (Niigata Univ., Japan). Japan. Heart J., 5: 180-7 (Mar. 1964).

The case of a reticulosarcomata that caused complete atrioventricular dissociation is reported. The effects of prednisolone treatment and precordial ^{60}Co γ irradiation on the tumor and on the electrocardiogram (ECG) are described. Data are reviewed for seven other reported cases of complete atrioventricular dissociation of the heart caused by the secondary cardiac tumor involving the conductive system of the heart. (TCO)

39036 ON THE PRODUCTION AND MEDICAL USE OF POLYVINYLPYRROLIDONE LABELLED WITH H^3 OR I^{131}. H. Koch, K. Seige, H. Loebe, and H. Hartmann (Karl-Marx-Universität, Leipzig). Kernenergie, 7: 507-9(June-July 1964). (In German)

A method is described for the labeling of polyvinylpyrrolidone and for the determination of polyvinylpyrrolidone in feces, urine, and blood serum. The method for determination, suitable for tests in vivo, involve activity measurements and is used with advantage in the diagnosis of exsudative enteropathy. While the product labeled with iodine provided greater insight into the metabolic processes, the product labeled with tritium yielded more accurate and more reproducible results. (OTS)

39037 THE IODINE ISOTOPES ^{125}I, ^{131}I, AND ^{132}I IN THYROID DIAGNOSIS. Toelke Lafrenz (Universität, Bonn). Med. Welt, 29: 1537-41(July 21, 1962). (In German)

For routine diagnosis of thyroid disorders with radioiodine several procedures and isotopes have proven to be useful. Initial evaluation of thyroid status has been made on the basis of percent uptakes found 15 to 30 min after administration of 10 μC or less of ^{132}I. The advantage of this radioisotope is that its half life is only 2.3 hr, so that other thyroid tests can be conducted within 24 hr of its administration. Also, radiation exposure of the patient is less than when ^{131}I is used. In normal patients the usual uptake at 15 min is between 12 and 19%. This value is higher in I-deficiency states, where there is no increased hormone production. In order to distinguish thyroid hyperfunction from goiter the patient is given 200 γ of triiodothyronine. A subsequently increased 24 hr ^{132}I uptake indicates hyperfunction, independent of hormonal regulation. Often in toxic adenomatous thyroids the uptake is normal, although there may be areas of above normal uptake within the thyroid. In order to measure hormonal function in endocrine ophthalmopathy, for example, where it is not practicable to use short-lived ^{132}I, ^{131}I can be used. However, ^{125}I, with a half life of 60 days, can also be used here because it imposes a smaller radiation burden on the patient than ^{131}I does. In the thyroid itself there is little or no lessening of the dose when

^{125}I is used instead of ^{131}I, when the same amounts of the two radioisotopes are used. In the entire body and gonads, though, there is a marked reduction of the radiation dose when ^{125}I is used. This is particularly true for thyroid hyperfunction. It should also be possible to use ^{125}I for thyroid scintigrams, but this will require solutions to several problems of measurement, including development of specialized collimators and counting heads. (BBB)

39038 CHANGES IN PERIPHERAL BLOOD OF CANCER PATIENTS TREATED BY X RAYS AND ITS RELATION TO THE VOLUME DOSE. Hisashi Ohtake and Toru Yanagisawa (Iwate Medical Coll., Japan). Nippon Igaku Hoshasen Gakkai Zasshi, 21: 1098-1101(Feb. 25, 1962). (In Japanese)

The changes of peripheral leucocyte and lymphocyte counts of 40 patients with malignant tumors were examined during deep x-ray therapy, and the changes of the peripheral blood figures are considered in relation to the volume dose calculated for each case. The cases were divided in three groups, i.e., subjected to irradiation over cervical, thoracic, and abdominal regions. However, in the abdominal group only a few cases were available. In the thoracic region group the decrease of leucocyte and lymphocyte counts were much more marked than in the cervical group. (BBB)

39039 QUALITY OF AN X-RAY BEAM. Albert G. Richards (Univ. of Michigan, Ann Arbor). Oral Surg. Oral Med. Oral Pathol., 17: 739-44(June 1964).

Various parameters which influence the quality of x rays, especially in the energy range used for medical and dental radiodiagnosis, are discussed. New data are reported on the relation of patient exposure to x-ray intensity and filtration of the beam. Some of these factors, which modify the total number of photons involved in a given radiographic exposure and their distribution within the range of energies imposed by the tube voltage, are the time of exposure, tube current, and filtration of the beam. The quality of an x-ray beam, which is a measure of its ability to penetrate matter, is described by its energy spectrum, which in turn can be described graphically by plotting the energy possessed by each photon against the number of photons exhibiting this amount of energy. This can be done automatically with a scintillation spectrometer, an electronic device which consists of a NaI scintillation crystal, a photomultiplier tube, a multichannel pulse-height analyzer, and a device for either plotting the resulting spectrum as a graph or for typing a permanent record of the coordinates of each point appearing in the spectrum. The effects of changing kilovoltage and current on the quality of the beam are described. Maximum energy of the beam is controlled by the kvp value, and increased current flowing through the x-ray tube proportionately increases the number of photons present in each energy level. Filtration changes both the quantity and the quality of the resultant beam of x rays. For practical purposes, both the quantity of radiation and the range of energies present in the beam diminish with increased filtration. A consideration of relative exposure times is presented, the results of which contradict the widely held opinion that a 90-kvp beam must be filtered with 2.5 mm of Al to reduce the patient's exposure by the lower-energy portion of the beam to the same level achieved when a 65-kvp beam filtered with 1.5 mm of Al. It was shown that because a beam generated with 90 kvp produces more radiation per sec than one generated with 65 kvp, the exposure time need be only 40% as long. The 65-kvp spectrum for one unit of time with total filtration equivalent to 2.0 mm of aluminum was compared with the 90-kvp spectrum for 0.4 unit of time with the same filter. The difference between the two spectra indicates that, with equal filtration and when the relative times of exposure are considered, the 90-kvp beam delivers fewer lower-energy photons to the dental patient's face. These findings are not in accord with official pronouncements that require the dentist to use thicker filters, rather than equal or even thinner ones, when elevated voltages are employed. (BBB)

39040 THE MANAGEMENT OF THE GLIOMATA. Arthur Jones (St. Bartholomew's Hospital, London). Proc. Roy. Soc. Med., 56: 673-80(Aug. 1963).

Some of the problems involved in irradiation of tumors arising from neuroglia are discussed, including optimal dosage, protection of healthy brain tissue, use of radiosensitizers, hyperoxygenation, and hypothermia, and complications of radiotherapy. It is pointed out that the radiosensitivity of normal nervous tissue is of paramount importance in the radiotherapy of gliomata. Radiobiologically, the balance lies between suppression of reproductive capacity of the tumor and the production of somatic injury in the host. Results reported for radiotherapy using doses of γ and 15-Mev x radiation of 4500 to 5500 rads. (C.H.)

39041 THE PLACE OF RADIOBIOLOGY IN THE TRAINING OF RADIOTHERAPISTS. Henry S. Kaplan (Stanford Univ., Palo Alto, Calif.). Progr. Radiation Therapy, 2: 225-32(1962).

In the training of the radiation therapist, it is pointed out, for many years teaching in clinical oncology and in radiological physics has been strongly emphasized in residency programs, but commensurate emphasis has not been placed on the teaching of radiobiology. A large part of the difficulty, it is suggested, stems from the fact that many radiology departments are still attempting to train general radiologists, who receive a preponderance of diagnostic training to which is appended training in radiotherapy that is grossly inadequate in terms of both total time and intensity. The radiobiology program suggested here is intended primarily, though not exclusively, for individuals who are seeking a full-time career in radiotherapy and who, to this end, have undertaken a three- to four-year radiotherapy residency and/or fellowship program. The program is outlined in terms of lecture courses and lab exercises and problems. The lecture course, which may be of variable duration and depth, should emphasize the cellular effects of ionizing radiations, though some lecture time should be spent on such topics as acute mammalian radiation lethality, effects of radiations on mutation and on population genetics, late somatic effects of radiation, including carcinogenesis and decreased longevity, and medical aspects of radiation protection. The residents should previously have had at least an introductory course in radiologic physics and radiation chemistry. A course outline is presented which emphasizes lectures in physics, radiation chemistry, and cellular biology. Topics covered in each of these subjects are discussed. Where appropriate facilities are available, residents and fellows in radiation therapy should have an opportunity for laboratory experience in radiation biology. This may take the form either of demonstration exercises, in which well-established phenomena are repeated merely for the educational experience of observing them at first hand, or of research training in which an attempt is made to investigate original problems, preferably under the close supervision of an experienced scientific supervisor. A minimal lab facility should have space for housing at least a small number of animals, usu-

ally mice, rats, and hamsters. Eight lab exercises are presented as suggestions, based on their relative simplicity, their pertinence to clinical radiotherapy in terms of the elucidation of basic principles, and their relatively low cost. Residents assigned to such lab exercises should also be encouraged to search the literature for the original contributions in each of these fields and to compare their own data with those reported by other investigators. (BBB)

39042 PROSPECTIVE USE OF NEGATIVE Pi-MESONS IN THERAPY. C. Stuart and G. Cittadini (Università, Siena, [Italy]). Radiazioni Alta Energia, 1: 209-18(Oct. 1962). (In Italian)

A synthetic and critical view of the present physical and biological notions on the mesons is drawn underlining the importance which they may have on the future of high energy therapy and major prominent practical and theoretical points are synthesized on the following three considerations: the distribution of the dose at the focus is excellent and definitely superior to the one obtained with other particles including rapid protons; the RBE of the mesons is difficult to evaluate although, on the strength of a preliminary approximation, they may be identified as that of other particles; the negative pi-mesons are not presently utilized in therapeutical practice in view of the fact that the mesonic beam obtained with the normal accelerators is not intense enough in order to reach acceptable focus doses. (auth)

39043 SERIES OF ISODOSES FOR FIXED THERAPY WITH Co^{60} INDEPENDENT OF INDIVIDUAL VARIABLES. Pietro Patrese (Università, Padua and Ospedale Civile, Padua). Radiazioni Alta Energia, 1: 219-40(Oct. 1962). (In Italian)

A series of isodoses made up of 2-3-4 fields of various angles for fixed therapy with ^{60}Co which are independent both of the patient's bulk and of distance of the skin tumor to be radiated is proposed. They offer the advantage that they may be used for all patients and for the various localizations of the tumor. Moreover, they offer an immediate view of the size and shape of the region for the maximum dose, with the possibility of a rapid and easy choice. In addition, it was possible to study the modifications of the shape and area for the maximum dose in relation to the modification of the inclination of the fields. Thereafter the limits of the methods are set forth with regard to the various powers and the limits of error which were shown to be variable from ±5 to 7%. (auth)

39044 CONSIDERATION OF SOME PHYSICAL AND BIOLOGICAL PROPERTIES OF FAST PROTON BEAMS. Carlo Stuart (Università, Siena, [Italy]). Radiazioni Alta Energia, 2: 109-22(July 1963). (In Italian)

The problem of the practical utilization of fast protons is reviewed, showing their physical and biologic characteristics, particularly compared with those inherent to a photon bundle. It follows that the modalities of protons-matter interaction present favorable therapeutic characteristics. The theoretical and practical premise for the utilization of these particles in a wider experimental field is presented. (auth)

39045 MEASUREMENT FOR DEFINING THE VISUAL FIELD AND RESOLUTION OF COLLIMATORS FOR FUNCTIONAL DIAGNOSIS AND SCINTIGRAPHY OF THE THYROID WITH I^{131}. Herbert Luethy (Burgerspital, Basel). SRW News, No. 22, 19-21(1964).

The counting rate measured over the thyroid with scintillation counter is too high when the crystal is inadequately shielded. This error is especially important when the uptake values are low. It is shown that the directional characteristics of the Siemens collimators constructed for functional diagnosis comply fairly well with the recommendations of the IAEA. The geometric resolution of the scintigraphic collimator can be determined with a point source or flat source. However, the sensitivity relationship of the collimators with respect to each other varies for point and flat sources. (auth)

39046 SURGICAL TREATMENT OF IRRADIATION INJURIES OF THE PERINEUM. William E. Barnes, George W. Hoffman, and Kenneth Pickrell (Duke Univ., Durham, N. C.). Surg. Gynecol. Obstet., 118: 1067-72 (May 1964).

Permanent chronic changes will develop in all skin that has been exposed to heavy or repeated doses of x rays, and even small doses of radiation will cause damage in the perineum. Progressive changes take place in the skin, leading eventually to local tissue atrophy. This thin atrophic epithelium is easily traumatized, and thus a portal of entry for bacteria is established. Superficial excoriations develop, with perpetual exudation in the area, causing discomfort and increasing the danger of contamination of the wound. The previously damaged cells offer little resistance to bacteria and thus allow infection to occur which results in impairment of blood supply to the area. The skin soon shows thickening, increased pigmentation, edema, fissuring, and eventually ulceration. The ulcer caused by x rays is characteristically punched out in appearance with sharp edges and a necrotic base. The course of this condition is not altered appreciably by any known drugs or other means of treatment except surgical therapy. The immediate objective of surgery is partially to denervate the area, causing temporary loss of sensation and an increase in blood supply. In most patients, however, the treatment is excision and repair of the area. Plastic surgical techniques are described and illustrated with reference to 13 cases of perineal radioulceration. The dosage varied from 900 to 13,000 R in these patients, but the degree of injury did not directly correspond to the x-ray dosage given. Of the 17 patients treated by surgical means, biopsy of ulcer with curettage was conducted in two, excision with primary closure in 6; excision with split skin graft in two; excision with coverage by pedicle flaps in 6; and radical vulvectomy with bilateral groin dissection in one patient. It is suggested that satisfactory results cannot be obtained unless the entire involved area is excised down to as normal appearing tissue as possible. It may prove necessary to take a portion of underlying bone, for example, in ulcers overlying the sacrum and the coccyx, in order to reach this normal tissue. Reconstruction is usually difficult since, even though an adequate graft or pedicle flap may be securely applied; rejection of these is common because of persistent moisture in the area, poor blood supply, and resulting impending infection. Postoperative complications are therefore relatively high. Many patients are in the upper age group and tolerate poorly repeated trips to the operating room and subsequent periods of immunobilization. (BBB)

39047 INTRA-ARTERIAL HYDROGEN PEROXIDE AND IRRADIATION FOR TUMORS OF THE HEAD AND NECK: A PRELIMINARY REPORT. D. A. Corgill (Veterans Administration Hospital, Dallas). Trans. Am. Acad. Ophthalmol. Otolaryngol., 67: 790-800(Nov.-Dec. 1963).

The intra-arterial infusate consisting of 250 ml of 0.12% hydrogen peroxide in Ionosol T was administered to four

patients. X-ray doses of 200 R were given at daily intervals toward the end of the infusion. This combination of therapy was continued until irradiation tolerance of the tissue was reached. Complications of the combined therapy are described. Experiments were conducted in dogs in efforts to find means to prevent these complications. In the four clinical cases with cancers of the head region, the intracarotid infusion of hydrogen peroxide before irradiation appeared to markedly enhance radiosensitivity of the tumor. It is concluded that the intra-arterial method of administering hydrogen peroxide is dangerous, but with massive radioresistant, or inoperable tumors its use appears to be justified. It is suggested that a safer method of administering hydrogen peroxide can be devised. (OTS)

39048 THORACIC DIAGNOSIS AND RADIATION EXPOSURE. Karlheinz Hopf (Tuberkuloseberatungsstelle fur die Kreise Querfurt and Nebra, Querfurt, Ger.). Z. Aerztl. Fortbild., 55: 125-8(Feb. 1, 1961). (In German)

Studies were made of the x-ray doses delivered to the gonadal region during diagnostic x-ray procedures for tuberculosis. Measurements were made with ionization chambers placed in the sacral area. In procedures that included 30 thoracic x-ray photographs, where no protection was provided, the gonadal dose averaged 28 mR. When a protective shield was used during 100 similar photographs, the single average gonadal dose was only 1 mR. In 500 thoracic fluoroscopies the gonadal dose amounted to 2.4 mR. On the basis of these results the claim that thoracic photographs generally afford more protection to to the gonads than fluoroscopy is not justified. Without any protective measures a long-range heart-lung photograph can give 10 or more times as much radiation to the gonads than a fluoroscopy. The difference between the gonadal dose when protective measures are used for x-ray photography or for fluoroscopy is actually rather small. It seems evident that a well-controlled fluoroscopic study really does not result in any more gonadal exposure than a thoracic x-ray photograph performed with protective covering over the gonadal region, but this would certainly not be true if the fluoroscopy was carried out carelessly. The mechanical characteristics of fluoroscopic equipment should be improved constantly so that they will require fewer and less complex adjustments that are now required. This is especially important in large clinics, where as many as 100 patients may require fluoroscopy in a single day. Fluoroscopy of the thoracic region should be limited to an area of 13 × 18 cm, and normally should last only for a time period of from 8 to 20 sec. X-ray photographs of the thoracic region should be made only when the gonadal area is shielded. (BBB)

39049 INVESTIGATION OF THE GENERAL AND ALBUMIN-FIXED RADIOIODINE IN RADIOTHERAPY. Z. U. Bekmukhametova (Lab. of Radiation Biochemistry, USSR). p.59-63 of "Radiatsionnye Effekty v Biologicheskikh Sredakh i Organizmakh i Metody ikh Issledovaniya." Tashkent, Publishing House of the Sciences, 1964. (In Russian)

A study was made of thyroid biochemistry, composition of iodide components in therapeutic applications of iodine, and the disturbance in the circulating thyroidal hormone during radiotherapy. The data indicate that therapeutic doses of iodine induced a secondary increase in blood radioactivity and a much higher protein-bound ^{131}I level in patients suffering from thyroid toxicity than in controls. Moreover the iodine level had an increasing tendency for 10 to 20 days. Shock doses of radioiodine effect the organism stronger but are excreted faster than fractionated doses, which remain in the gland longer. The general increase in blood ^{131}I is due to destructive processes in the thyroid gland and decay product secretion. (R.V.J.)

CHEMISTRY

General

Refer also to abstracts 39478 and 40813.

39050 (IS-950) BIBLIOGRAPHY OF REVERSED-PHASE PARTITION CHROMATOGRAPHY. C. E. Hedrick and James S. Fritz (Ames Lab., Ames, Iowa). July 1964. Contract W-7405-eng-82. 20p.

A total of 163 references are presented under the categories Reviews, Paper and Thin Layer Chromatography, and Column Chromatography. The last category also has subcategories on modified silica, polyethylene, rubber, fluorocarbon, and other polymeric supports. (D.L.C.)

39051 (NAA-SR-8448) CHROMATOGRAPHIC ANALYSIS OF GASES OVER LIQUID SODIUM. Donald L. Johnson (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Sept. 15, 1964. Contract AT(11-1)-Gen-8. 32p.

A gas chromatograph was incorporated into a recirculating loop in which helium was pumped from a Na-filled capsule to the chromatograph. The helium was analyzed for fixed gas content and then returned to the capsule. Analysis of He, bubbled through carbon-saturated Na, revealed the gaseous impurities H_2 (1.0 vol %), CH_4 (0.03 vol %), and N_2 (1.0 vol %). These gases appeared in lower concentrations over low-carbon Na. Neither CO nor CO_2 was detected at temperatures up to 1200°F. The presence of H_2 and CH_4 indicates that one of the mechanisms of carburization is related to H_2 and is a function of the ratio $P_{CH_4}/P^2_{H_2}$, the activity of sodium hydride (NaH), and the equilibrium constants for the following reactions: $C + 2H_2 \rightleftharpoons CH_4$ and $Na + \frac{1}{2}H_2 \rightleftharpoons NaH$. Hydrogen partial pressure in He can be used to determine the H_2 content in sodium below 1 ppm. Gas chromatography has been used to analyze cover gas samples taken from liquid Na reactors, and it is adaptable to the analysis of gases over flowing liquid metals in closed loops. (auth)

39052 (NP-14251) BIBLIOGRAPHY ON THE HIGH-TEMPERATURE CHEMISTRY AND PHYSICS OF GASES AND GAS-CONDENSED PHASE REACTIONS. No. 12. L. Brewer, comp. (California. Univ., Berkeley). June 30, 1964. 24p.

The bibliography is in sections on reactions between gases and condensed phases and on spectroscopy of interest in high-temperature chemistry. 236 references are included. (J.R.D.)

39053 (AERE-Trans-1005) FLUORESCENCE SPECTROSCOPY. E. Lippert. Translated by G. Burger (U.K.A.E.A. Atomic Energy Research Establishment, Harwell, Berks, Eng.), from p.305-15 of Vol. II, Pt. 1, "Ullmanns Encyklopadie der Technischen Chemie," München-Berlin, 1961. 21p.

A review is presented of fluorescence spectroscopy. The nature of fluorescence is discussed. Analytical applications of fluorescence are considered, and studies of excited molecular states and radiationless deactivation processes are described. Finally, measuring methods and instruments are discussed. (D.L.C.)

Analytical Procedures

Refer also to abstract 38736.

39054 (AE-151) DETERMINATION OF MAGNESIUM IN NEEDLE BIOPSY SAMPLES OF MUSCLE TISSUE BY MEANS OF NEUTRON ACTIVATION ANALYSIS. D. Brune and H. E. Sjoeberg (Aktiebolaget Atomenergi, Stockholm). July 1964. 8p. (UDC-543-54; UDC-546-46)

Magnesium was determined by means of neutron-activation analysis in needle biopsy samples of muscle tissue of the order of magnitude 1 mg dry weight. The procedure applied was to extract the ^{27}Mg activity from irradiated muscle tissue with concentrated hydrochloric acid followed by a fast hydroxide precipitation and gamma-spectrometric measurements. The ^{27}Mg activity was recovered in the muscle tissue samples to (97 ± 2) per cent. The sensitivity for the magnesium determination is estimated as 0.3 μg. (auth)

39055 (AEET/ANAL/30) DETERMINATION OF SILICON IN THORIUM NITRATE. S. R. Desai, Kum. N. Savitri, and M. S. Varde (India. Atomic Energy Establishment, Trombay). 1964. 7p.

A modified method for the spectrophotometric determination of silicon in thorium salts has been developed. By using EDTA to complex thorium, it is possible to work at pH 2.5 or even lower instead of the critical value of 3.0 above which the absorbance of the molybdisilicic acid falls. The necessity for making the absorbance measurements within 5 minutes of the reduction of the silico-molybdate complex is obviated since the color is stable for at least 24 hours. An improved precision is obtained; the relative standard deviation is 4% as against 13% reported in the earlier method. (auth)

39056 (AERE-R-4474) ANALYSIS OF ZINC AND COPPER ORES BY RADIOISOTOPE X-RAY FLUORESCENCE. J. R. Rhodes, T. G. Ahier, D. O. Poole (United Kingdom Atomic Energy Authority. Research Group. Wantage Research Lab., Wantage, Berks, England). Aug. 1964. 40p. (CONF-655-1)

From Symposium on Analytical Instrumentation, Windscale, Cumb., Eng., Dec. 1963.

The use of differential filters in radioisotope x-ray fluorescence analysis of Zn and Cu is discussed. Suppression of interelement effects and matrix absorption is considered. Experimental results are presented for "on-stream" analyses of Zn ores and laboratory analyses of Cu ores. (D.L.C.)

39057 (CONF-520-1) SPUTTERING ANALYSES WITH A CASCADE MASS SPECTROMETER. T. Leo Collins, Jr., and James A. McHugh (Knolls Atomic Power Lab., Schenectady, N. Y.). May 1964. Contract W-31-109-eng-52. 15p.

From Conference on Mass Spectrometry, Paris, Sept. 1964.

The method of generating positive ions by sputtering is shown to be of value for the isotope abundance analysis of small solid samples. The small sample efficiency of this source makes possible the mass analysis of a number of elements which perform poorly in thermal sources. The analysis of less than 10^{-8} gram samples of Be, B, Ni, Cu, Ag, and Sn was accomplished. Preliminary data indicate

that the sputtering method may be a useful analytical technique for measuring the oxygen concentrations in Nb. (auth)

39058 (EUR-1643.e(p.275-300)) ELECTRON MICROPROBE ANALYSIS OF NUCLEAR MATERIALS. R. Theisen (European Atomic Energy Community. Joint Nuclear Research Center, Ispra, Italy).

X-ray microanalytical methods must be adapted for use in nuclear materials research; the extension of electron microprobe analysis to cover tracer analysis and quantitative determinations in the presence of radioactive materials is described. Quantitative evaluation methods in the presence of the heavy elements, uranium and plutonium, were developed; the resultant calculated values concurring with experimental determinations of calibration standards. The applications include studies of intermetallic diffusion, radiation damage, corrosion mechanisms, phase transformation, and localized structural analysis. (auth)

39059 (NP-14260) ANALYSIS OF RADIONUCLIDES IN FOODS. (Public Health Service, Washington, D. C. and Robert A. Taft Sanitary Engineering Center, Cincinnati). Feb. 1964. 189p.

This manual was compiled for use in a course designed for professional personnel having responsibilities for the analysis of radioactive materials in milk and food. The entry of radionuclides into biological food chains, fundamental radiochemical and radiometric procedures, and calibration techniques are reviewed. Analytical techniques are presented with emphasis on methods for the determination of total γ activity, Sr isotopes, I isotopes, and Ra in food and milk. 120 references. (C.H.)

39060 (RT/CNI(63)-1) DESCRIZIONE DI TECHNICHE E METODI DI USO COMUNE NEL LABORATORIO DI ANALISI TOSSICOLOGICHE DEL C.S.N.–ISPRA. (Description of Technics and Methods Used by the Radiotoxicology Laboratory of C.S.N.–Ispra). V. Camera (Italy. Comitato Nazionale per l'Energia Nucleare, Rome). Jan. 1963. 63p.

The analytical methods used by Radiotoxicology Laboratory of CSN-Ispra for the period 1958 to 1961 are described. Various methods for urine analysis of the exposed staff have been studied with regard to α and β gross activity and to several radionuclides. In particular, ^{131}I was determined by distillation and counting, U either by fluorometry or by colorimetry with PAN, and Th by means of extraction and colorimetry with "Thoron." A spectrophotometric method for the determination of F in toxicological interest materials is also described. (auth)

39061 (TID-21072) ANALYTICAL CHEMISTRY AT LOW CONCENTRATIONS. Annual Report No. 8, July 31, 1964. John T. Stock (Connecticut. Univ., Storrs). Contract AT(30-1)-1977. 9p.

Reports on: the amperometric titration of low concentrations of nitrite, the solubility of mercury(II) chloride and lithium chloride in ethylenediamine, the properties of c reference electrode that employs solutions in ethylenediamine, and the polarography and analytical uses 8-substituted quinaldines and quinaldinic acids are summarized. Considerable progress was made in the development of a technique that permits the direct amperometric titration of iron(III) at concentrations of only 10^{-5} M. Work on the amperometric microtitration of chloride-bromide mixtures and the controlled-potential coulometry of certain simple derivatives of quinoline was initiated. (auth)

39062 (AEC-tr-6390(p.372-7)) RAPID DETERMINATION OF THE PERCENT CONTENT OF LEAD IN CONCENTRATES. A. A. Abdullaev, S. A. Bibinov, E. M. Lobanov, A. P. Novikov, and A. A. Khaidarov. Translated from Tr. Tashkentsk. Konf. po Mirnomu Ispol'z. At. Energii, Akad. Nauk Uz. SSR, 2: 282-?(1960).

An instrument was designed for the rapid determination of the percent content of lead in powdered ore samples and concentrates by registration of scattered beta or gamma radiation. The radiation sources used were ^{204}Tl and ^{75}Se. The sample to be analyzed and a standard are irradiated simultaneously. The scattered radiation from the sample and standard is registered by two end-window counters. A compensation method is used and if the lead contents of both samples of the same the indicator showes an arbitrary zero. When the lead contents are different, a current passes through the instrument and the pointer is deflected across a claibrated scale, which shows the percent of lead in the sample. (M.C.G.)

39063 (AEC-tr-6390(p.429-31)) SEPARATION OF THE RARE EARTH GROUP U^{238} PHOTOFISSION FRAGMENTS BY THE METHOD OF CONTINUOUS ELECTROPHORESIS. V. P. Shvedov, K. A. Petrzhak, R. V. Sedletskiĭ, and A. V. Stepanov. Translated from Tr. Tashkentsk. Konf. po Mirnomu Ispol'z. At. Energii, Akad. Nauk Uz. SSR, 2: 325-?(1960).

The possibility of using electrophoresis to determine the rare earth isotopes formed in the fission of ^{238}U was investigated. A 0.01% solution of trilon B at a pH of 1.94 served as the electrolyte and the separation was performed at a potential gradient of about 10 v/cm. The time needed was 2 hr 26 min. The radioisotopes obtained were identified according to half life. (M.C.G.)

39064 (AEC-tr-6390(p.564-70)) PROCEDURE AND APPARATUS FOR THE CHROMATOGRAPHIC INVESTIGATION OF HYDROCARBON RADIOLYSIS PRODUCTS. V. G. Berezkin. Translated from Tr. Tashkentsk. Konf. po Mirnomu Ispol'z. At. Energii, Akad. Nauk Uz. SSR, 2: 425-?(1960).

The chromatographic analysis of irradiated hydrocarbons is discussed. A successive scheme for chromatographic analysis, which eliminates some of the shortcomings of the parallel scheme, is proposed. (M.C.G.)

39065 INVESTIGATIONS ON ION-EXCHANGE EQUILIBRIA WITH RADIOACTIVE TRACER METHOD. VIII. USE OF EQUILIBRIUM DATA FOR PREDICTION OF ION-EXCHANGE SEPARATION EFFICIENCY. Árpad Jász and Tamas Lengyel (National Atomic Energy Commission, Budapest). Acta Chim. Acad. Sci. Hung., 40: 167-73(1964).

Starting out from static equilibrium measurements investigations were carried out on the possibilities of selective separation. The experiments performed with the system $Tm^{3+}-Y^{3+}$ yielded a positive result, enabling the prediction of separation possibilities, based on the relations obtained by using the concept of theoretical plates. (auth)

39066 THE APPLICATION OF ACTIVATION ANALYSIS IN BIOCHEMISTRY; QUALITATIVE ANALYSIS OF HAIR SAMPLES WITH THE AID OF THE γ SPECTRUM AFTER NEUTRON IRRADIATION IN THE NUCLEAR REACTOR. J. Ruttink. Acta Physiol. Pharmacol. Neerl., 11: 515-16(1962).

The use of neutron activation analysis in toxicologic studies for detection of various elements in human hair is described, and the γ-ray spectrum of hair after activation

of its constituent elements by neutron irradiation, after various periods allowed for decay, is discussed. Attempts were made to find which elements determine the characteristics of hair γ spectra. Thus in four human hair samples four elements could be detected in the total spectrum: Cl, Na, Br, and Zn. After a nonquantitative chemical analysis, the spectra of Cu and Au could also be found. Of these, Au had not been found previously in hair. (C.H.)

39067 TECHNIQUE FOR RAPID ANALYSES OF CORN LEAVES FOR ELEVEN ELEMENTS. Dale E. Baker, G. W. Gorsline, C. B. Smith, W. I. Thomas, W. E. Grube, and J. L. Ragland (Pennsylvania State Univ., University Park). Agron. J., 56: 133-6(1964).

An investigation was conducted to develop methods for an overall analytical technique for corn leaf analysis. Samples were analyzed by use of a spectrometer for Sr, P, K, Ca, Mg, Mn, Cu, B, Al, Fe, and Zn. Computing equipment was used to speed and facilitate data conversion. Procedures for sampling, leaf washing, drying, grinding, mixing, ashing, and analysis were studied and modified, where necessary, to increase precision and accuracy with respect to all elements. (auth)

39068 DERIVATIVE ACTIVATION CHROMATOGRAPHY. Joseph M. Steim and A. A. Benson (Pennsylvania State Univ., University Park). Anal. Biochem., 9: 21-34 (Sept. 1964).

Although most biologically important compounds do not contain atoms that produce a useful radionuclide by thermal neutron capture, activation analysis was extended to these cases by the use of easily formed derivatives that do contain activatable atoms, such as bromine. Sensitive qualitative and quantitative analyses for mixtures of many compounds were obtained by paper chromatography of such derivatives, followed by neutron activation of the chromatograms in a nuclear reactor. p-Bromophenacyl esters of carboxylic acids, p-bromophenylsulfonamides of amino acids, p-bromophenylhydrazones of keto acids and sugars, and mercuriated fatty acids were separated and activated. Induced activities were located by radioautography and measured by appropriate detectors. Comparisons of radioactivities in separated compounds with those in suitable standards allowed quantitative estimations. The method is generally more sensitive than conventional chemical spray methods, and quantification is less troublesome. (auth)

39069 A SIMPLE METHOD FOR SOFT TISSUE MAGNESIUM AND CALCIUM. W. Joseph Rahill and Mackenzie Walser (Johns Hopkins Univ., Baltimore). Anal. Biochem., 9: 119-22(Sept. 1964).

A method is described for the recovery of injected ^{47}Ca and ^{28}Mg in muscle and kidney tissues in rats. Heat coagulation of proteins at a pH near 4.6 yields a filtrate that can be titrated directly for Ca and Mg without heavy metal interference. The filtrate is then titrated with EDTA using eriochrome black T or Cal-Red as indicators. (P.C.H.)

39070 A LOW-LEVEL CARBON-14 COUNTING TECHNIQUE. L. T. Freeland (E. I. du Pont de Nemours & Co., Wilmington, Del.). Anal. Chem., 36: 2055-7(Oct. 1964).

Liquid scintillation spectrometry proved useful in the dating of ^{14}C containing artifacts. However, most ^{14}C dating methods involve a tedious and usually low yield preparation of a suitable solvent for liquid scintillation spectrometry. The possibility of isotope effects is present in some of these procedures. A technique is described that circumvents these limitations. The method requires the combustion of the sample to CO_2, absorption of the CO_2 in sodium hydroxide solution, followed by reaction with phenylmagnesium bromide to form benzoic acid. The benzoic acid-^{14}C is esterified to methyl benzoate. This methyl benzoate is the solvent used in the assay of the sample by liquid scintillation spectrometry. (auth)

39071 APPLICATION OF CONTROLLED POTENTIAL ELECTRODEPOSITION WITH PYROLYTIC GRAPHITE ELECTRODES TO NEUTRON ACTIVATION ANALYSIS AND RADIOCHEMISTRY. Harry B. Mark, Jr. and Francis J. Berlandi (Univ. of Michigan, Ann Arbor). Anal. Chem., 36: 2062-4(Oct. 1964).

A combination controlled-potential coulometric separation and neutron activation technique is described. This technique takes advantage of the selectivity of electrodeposition for the separation of the species of interest from other constituents with the extreme sensitivity of activation analysis. Pyrolytic graphite is used as the electrode for the deposition of the species of interest as it is of such extreme purity and low capture cross section that it gives a negligible background count after irradiation in the reactor. Thus, on activation of the electrode disk with the deposited film of the element to be determined, the resulting activity in the photo-peak of the gamma spectrum is easily identifiable to the element of interest and used to determine quantitatively the amount present on the electrode. As the deposition is carried out under controlled potential and electrolysis time, the initial concentration in the sample solution is readily determined. With the negligible background of the pyrolytic graphite, the sensitivity of determinations by this method is limited only by the sensitivity of the element for activation analysis (cross section) and the flux of the reactor. The applicability of the method to the analysis of mixtures is also discussed. (auth)

39072 A RAPID RADIOCHEMICAL ANALYSIS FOR AMERICIUM-241. Milton H. Campbell (General Electric Co., Richland, Wash.). Anal. Chem., 36: 2065-7(Oct. 1964). (HW-79770)

Americium(III) is quantitatively separated from nitric acid solutions by liquid-liquid extraction with di(2-ethyl hexyl) orthophosphoric acid with no valence adjustment. Americium recoveries are presented as a function of acid molarity and extractant concentration. The effect of diverse ions upon the determination is presented, and complexants are recommended for improving yields in the presence of ferric and fluoride ions. Decontamination factors for plutonium, uranium, and neptunium are presented. ^{241}Am yield for this analysis is 99.2% with a standard deviation of ±0.8%. (auth)

39073 DETERMINATION OF SILVER, CADMIUM, INDIUM, TANTALUM, RHENIUM, GOLD, AND RARE EARTHS AT LOW CONCENTRATION BY NEUTRON ACTIVATION AND RADIOCHEMICAL ANALYSIS. Chester E. Gleit (Tracerlab, Richmond, Calif.), Philip A. Benson, Walter D. Holland, and Irving J. Russell. Anal. Chem., 36: 2067-72(Oct. 1964).

Five types of organic filter media and high-purity quartz were analyzed for Ag, Cd, In, Tb, Ho, Er, Tm, Ta, Re, and Au. Organic matter was removed by reaction with electrically excited oxygen before neutron irradiation. After irradiation, radiochemical separations stressing rigorous purification were utilized. A combination of beta counting and gamma spectrometry was employed to determine the activity of the separated elements and to check sample purity. Concentrations as low as one part in 10^{11} were measured. Large differences in trace-element concentration were observed. In the most extreme case, four sheets of I.P.C. grade 107 filter paper displayed a 30-fold varia-

tion in Ag and Au concentrations. A study of the sources of experimental error indicated that the technique is capable of yielding quantitative data and that the observed variations are caused by nonuniformity among the specimens. (auth)

39074 COMPUTER ROUTINES FOR NEUTRON ACTIVATION ANALYSIS OF LUBRICATING OILS. D. E. Hull and J. T. Gilmore (California Research Corp., Richmond, Calif.). Anal. Chem., 36: 2072-7(Oct. 1964).

Compounded lubricating oils were irradiated with fast neutrons from a positive ion accelerator to determine 5 elements: nitrogen, phosphorus, chlorine, zinc, and barium. Gamma rays from their induced activities were recorded in a series of 100-channel spectra from a pulse-height analyzer. An IBM 7094 computer sorted out peaks, selected those corresponding to specified energies, and resolved the decay curves into components identifiable with the separate elements. By an iterative stripping procedure, mutual interferences were removed, and the quantity of each element present was determined by comparison with an irradiated standard. Results for barium, phosphorus, and chlorine were within a few percent of chemically determined concentrations, but interference between zinc and nitrogen made determination of these elements less accurate. The procedure required 1 to 2 hr to activate a sample and count its activity, and about 5 sec per sample of computer time. (auth)

39075 DETERMINATION OF RADIOACTIVE NOBLE GASES WITH A LIQUID SCINTILLATOR. Donald L. Horrocks and Martin H. Studier (Argonne National Lab., Ill.). Anal. Chem., 36: 2077-9(Oct. 1964).

Disintegration rates of the radioactive noble gases ^{222}Rn, ^{131m}Xe, and ^{85}Kr were measured with a toluene-base liquid scintillator. This was practical because of the high solubility of the noble gases in the aromatic hydrocarbons used as solvents in liquid scintillators. The distribution coefficients, the ratios of the concentrations of the noble gases in the liquid scintillator to the space above it, were measured. At −15°C, these were 5 and 32 for xenon and radon, respectively. The differential pulse height spectra of the light output of the liquid scintillator with dissolved radioactive noble gases are shown. (auth)

39076 EMISSION SPECTROGRAPHIC DETERMINATION OF BORON IN PLUTONIUM AND URANIUM NITRATE SOLUTIONS FOLLOWING CATION EXCHANGE SEPARATION. Albert W. Wenzel and Charles E. Pietri (Atomic Energy Commission, New Brunswick, N. J.). Anal. Chem., 36: 2083-6(Oct. 1964).

Trace amounts of boron were determined by emission spectrography following separation from plutonium or uranium in dilute nitric acid by cation exchange. Mannitol complexing was used to prevent boron losses in concentration of the boron-rich effluent by evaporation to dryness prior to the spectrographic determination. Boron is subsequently determined using a zinc internal standard and an indium oxide matrix by excitation in a d-c arc. The lower limit of detection varies from 0.007 to 0.001 μg of boron depending on the instrumental setup. The relative standard deviation for 0.1- to 2-g uranium samples in the 0.1- to 30-ppm range and 0.1- to 0.4-g plutonium samples in the 3- to 30-ppm range was within 9% while at the 0.05-ppm level in 2 grams of uranium it was 12%. Within experimental limits complete recovery of boron in all synthetic samples was obtained at all levels. The influence of the boron blank values at the 1- to 0.1-μg level is discussed. (auth)

39077 X-RAY FLUORESCENCE SPECTROMETRIC DETERMINATION OF ZIRCONIUM AND MOLYBDENUM IN THE PRESENCE OF URANIUM. E. A. Hakkila, R. G. Hurley, and G. R. Waterbury (Los Alamos Scientific Lab., N. Mex.). Anal. Chem., 36: 2094-7(Oct. 1964).

Zirconium and molybdenum in uranium–zirconium–molybdenum carbide were determined without chemical separation using an x-ray fluorescence spectrometric procedure. The mixed carbide was dissolved in nitric-hydrofluoric acid, niobium was added to serve as an internal standard, and the solution was irradiated using a tungsten-target x-ray tube. The ratios of the intensities of the K_α lines for zirconium and niobium and of the K_β lines for molybdenum and niobium were measured. Corrections, which were a linear function of uranium concentration in the range between 30 and 100% of uranium, were applied to each intensity ratio. The procedure is applicable to the determination of 5 to 50% each of zirconium and molybdenum with a relative standard deviation of 1 to 2%. Foreign elements of high mass absorption coefficient interfere when present in concentrations greater than approximately 10% for the determination of molybdenum, or 20% for the determination of zirconium. (auth)

39078 REVERSED-PHASE PARTITION CHROMATOGRAPHIC SEPARATION OF SEVERAL ALKALINE EARTHS FROM EACH OTHER AND FROM YTTRIUM. Jerome W. O'Laughlin, George J. Kamin, David L. Berner, and Charles V. Banks (Iowa State Univ., Ames). Anal. Chem., 36: 2110-12(Oct. 1964).

The separation of trace amounts of calcium and magnesium from yttrium and the separation of calcium, magnesium, and strontium from each other is described. The former separation is achieved on a column packed with Kel-F impregnated with bis(di-n-hexylphosphinyl)methane and the latter on paper impregnated with the same reagent. Microgram amounts of calcium and magnesium were separated from up to 10,000 times as much yttrium and determined spectrophotometrically using the very sensitive chromogenic reagent, Chlorophosphonazo III. Calcium, magnesium, and strontium, following their separation using radial paper chromatography, were titrated coulometrically with a relative standard deviation of approximately 0.5% for mixtures containing about the same amount of each element. (auth)

39079 FLUOROMETRIC DETERMINATION OF URANIUM WITH RHODAMINE B. N. R. Anderson and David M. Hercules (Massachusetts Inst. of Tech., Cambridge). Anal. Chem., 36: 2138-41(Oct. 1964).

A rapid, direct fluorometric method for uranium was developed utilizing the reaction between the uranyl–benzoic acid complex and Rhodamine B. The uranyl complex is extracted into a benzene layer containing Rhodamine B, and the intensity of fluorescence produced is proportional to uranium concentration. The fluorescence intensity is a function of benzoic acid concentration, Rhodamine B concentration, pH, volume of the aqueous phase, and time of ultraviolet irradiation. A variety of cations and anions were checked for possible interferences. The lower limit of detection is about 5×10^{-8} M uranium (about 12 ppb). (auth)

39080 ANALYSIS FOR DEUTERIUM IN ORGANIC COMPOUNDS BY COMBUSTION—INFRARED SPECTROMETRY. James L. Lambert, James H. Hammons, Joseph A. Walter, and Alex Nickon (Johns Hopkins Univ., Baltimore). Anal. Chem., 36: 2148-51(Oct. 1964).

A method is described for the quantitative determina-

tion of deuterium in compounds by combustion and infrared spectrometry of the derived water sample. Combustion is effected conveniently by a dynamic combustion train, modified to remove acidic oxides and halogen from the combustion gases. The memory effect of this system was reduced to an acceptable level. Analysis on the milligram scale is possible. Results agree well with analyses by mass spectrometry and the falling-drop method. (auth)

39081 SEPARATION OF ISOTOPIC POSITION ISOMERS OF TRITIUM-LABELED OLEFINS BY GAS CHROMATOGRAPHY. E. K. C. Lee and F. S. Rowland (Univ. of Kansas, Lawrence). Anal. Chem., 36: 2181-3(Oct. 1964).

The gas chromatographic separation of monotritiated forms of olefinic hydrocarbons, differeng from each other only in the intramolecular location of the tritium atom. The separation mechanism is dependent both on the relative solubilities of the olefins in ethylene glycol and on the equilibrium constants for the Ag^+-olefin complexes. The Ag^+-complex equilibria are the dominant effect and the isotopic separations depend on isotopic effects in these equilibria. (M.C.G.)

39082 OPTIMUM COUNTING TIMES FOR m PEAKS AND BACKGROUND IN MASS SPECTROMETRY. Anal. Chem., 36: 2196-7(Oct. 1964).

Calculations for optimum counting times for m peaks and background in mass spectrometry were extended to cover the following situation. For a given sample all peaks of interest and background are measured in rapid succession. Assuming that the operator can control the amount of time spent counting each peak and background, how much of the total fixed counting time should be allocated to each. It was concluded that over one third of the time should be spent counting at background. (M.C.G.)

39083 DETERMINATION OF FREE CARBON IN HAFNIUM CARBIDE. George Feick (Arthur D. Little, Inc., Cambridge, Mass.) and William Giustetti. Anal. Chem., 36: 2198-9(Oct. 1964).

A method for determining free carbon in arc-melted hafnium carbide whose total carbon content corresponded to $HfC_{0.968}$ is described. A sample was treated with HNO_3 and HF and the white residue of basic salts was dissolved by the addition of KHF_2. When the few remaining dark particles were filtered off and examined under the microscope, they appeared translucent and dark red in color. It appeared to represent combined carbon that is incompletely oxidized during acid treatment. They were almost completely dissolved in 10% NaOH and any free carbon left was ignited and the resulting CO_2 measured. The measurements were consistent with metallographic results. (M.C.G.)

39084 A STUDY OF FLUX MONITORING FOR INSTRUMENTAL NEUTRON ACTIVATION ANALYSIS. Frank A. Iddings (Humble Oil and Refining Co., Baton Rouge, La.). Anal. Chim. Acta, 31: 206-12(Sept. 1964).

The accuracy of instrumental neutron activation analysis is dependent on measurement of the neutron flux to which samples are submitted. Flux monitoring techniques described and evaluated include: target cooling water activity, BF_3 counters, plastic scintillators, and a simple reference sample system. Evaluation was made on the basis of results obtained for oxygen analysis using primary standard materials. The superiority of the reference sample system for flux measurement during irregular neutron flux production is shown. (auth)

39085 THE SPECTROPHOTOMETRIC DETERMINATION OF VARIOUS METALS WITH FORMALDOXIME. Z. Marczenko (Technical Univ., Warsaw). Anal. Chim. Acta, 31: 224-32(Sept. 1964). (In French)

Formaldoxime forms highly colored complexes (ϵ = 4000 to 18000) with manganese, cerium, vanadium, nickel, and iron in alkaline media. On the basis of a study of reaction mechanisms and of the optimum conditions for the formation of the different complexes, spectrophotometric methods are described for determination of cerium and iron, as well as improved methods for determination of manganese, nickel, and vanadium. The use of formaldoxime for Mn, Ce, and V is considered particularly beneficial in trace analysis and the methods suggested are specific. (auth)

39086 DETERMINATION OF OXYGEN IN HELIUM BY WINKLER'S METHOD. K. G. Divekar, K. A. Khasgiwale, and M. Sundaresan (Atomic Energy Establishment, Trombay, India). Anal. Chim. Acta, 31: 289-92(Sept. 1964).

A reinvestigation was made of optimum experimental conditions to be followed in Winkler's method for determining oxygen in helium. The method is based on liberation of iodine from potassium iodide by the manganic salt produced when manganese(II) hydroxide is oxidized by the oxygen in the sample. The iodine liberated is then determined spectrophotometrically. It was found that a cumulative blank of 11 ± 5 μl O_2 was always inherent with the procedure and that was the lowest limit for analysis. (M.C.G.)

39087 THE DETERMINATION OF RADIOSTRONTIUM IN MILK AND HERBAGE. M. J. Owers and T. W. Evett (Central Electricity Generating Board, London). Analyst, 89: 544-50(Aug. 1964).

A method was developed for determining strontium-90 and strontium-89 in milk and herbage. No attempt was made to separate strontium from calcium during the analysis although standard radiochemical purifications are carried out. Strontium-90 is determined via its yttrium-90 daughter, and strontium-89 is determined by counting a mixed strontium–calcium source. Strontium-85 is added as a tracer at the beginning of the analysis to permit a correction for yield to be made by subsequent γ-ray counting. Experiments indicate that this analysis is substantially quicker, safer, and cheaper than earlier procedures, while retaining satisfactory precision and accuracy. (auth)

39088 LIQUID–LIQUID EXTRACTION OF METAL IONS. D. F. Peppard and G. W. Mason. Argonne Natl. Lab. Rev., 1: No. 3, 11-15(July 1964).

Chemical and physical principles involved in the liquid-liquid extraction of metal ions are discussed and theoretical expressions are given. (P.C.H.)

39089 DETERMINATION OF Sr^{90} IN SOIL. Alica Bauman and V. Popovic (Inst. for Medical Research and Occupational Medicine, Zagreb). Arhiv Hig. Rada Toksikol., 15: 3-8(1964).

A description is given of a method for site selecting and for determining ^{90}Sr in soil. In 1962 there were 4.35 mC of ^{90}Sr per square kilometer around Zagreb, in 1963 there were 7.43. (OTS)

39090 DETERMINATION OF COBALT, TITANIUM AND TANTALUM IN CEMENTED CARBIDES; SEPARATIONS BY ANION-EXCHANGE. Kakuzo Tada (Tokyo Shibaura Electric Co., Ltd., Kawasaki) and Hikoroku

Horiguchi. Bunseki Kagaku, 12: 799-803(1963). (In Japanese)

A rapid control method is proposed for the determination of cobalt, titanium, and tantalum in cemented carbides. The sample is dissolved in a mixture of hydrofluoric and nitric acids, and evaporated to dryness. The residue is dissolved in dilute hydrofluoric acid, and then transferred to a column of strong quaternary amine anion-exchange resin. Cobalt alone passes through the column, while titanium, tungsten, and tantalum remain adsorbed. Titanium and tungsten are removed by elution with a hydrochloric-hydrofluoric acid. Tantalum is collected in a separate eluate of ammonium chloride and ammonium fluoride solution. Cobalt is determined by chelatometry using EDTA, after eliminating hydrofluoric acid from the first eluate. Boric acid is added to the second and the third eluates to complex the hydrofluoric acid. Titanium is precipitated with tannin from ammoniacal solution, and tantalum is precipitated with cupferron from acidic solution. Titanium is determined by chelatometry after pyrosulfate fusion of the ignited oxide containing a little tungsten, and tantalum is determined by weighing the oxide. The time required for an analysis is approximately 8 hours. (auth)

39091 STUDIES ON THORIUM NITRATE TITRATION OF MICROAMOUNTS OF FLUORIDE. Wataru Funasaka, Teiichi Ando, and Hiroshi Ogiri (Kyoto Univ.). Bunseki Kagaku, 12: 1161-9(1963). (In Japanese)

In thorium nitrate titration of fluoride with Alizarin S indicator, a formate buffer was applied for adjusting the pH of the titrand in order to reduce interference from traces of oxidizing agents. Investigations were also made on the conditions of titration in the presence of large amounts of sodium nitrate or chloride (as in the analysis of fluorine in organic compounds). The end-point could be detected with satisfactory precision (σ = 2.5 to 4.5 μg F) by the aid of a color standard solution. Interference from carbonate ion could be easily eliminated by using an appropriate indicator for neutralization. Interference from oxidizing agents was reduced markedly by the reducing action of the formate buffer. Fluoride over the range of 190 μg to 3 mg could be titrated directly with 0.01N thorium nitrate solution with satisfactory accuracy and reproducibility. Composition of the buffer solution to be used had to be altered depending on the amount of co-existing sodium nitrate or chloride. (auth)

39092 THE DETERMINATION OF IODINE IN ORGANIC COMPOUNDS BY MEASURING THE INTENSITY OF THE REFLECTED β-RADIATION. P. Schiller. Chem. Zvesti, 17: 189-93(1963). (In Slovak)

A method, based on the fact that the number of reflected particles increases with the increase in the atomic no. of the element, was used for determining I in aqueous solutions of hexamethylenetetramine iodomethylate, N,N'-adipine-di-3-amino-2,4,6-triiodobenzoic methyl glucaminate, and iodotriethanolamine sodium thiosulfate. The sample was placed in an open dish and exposed to a ^{204}Tl-β-ray source above it. The radiation was reflected to 2 slanted end-window G-M counters connected in parallel to a nuclear counter. The sample, its support, the radiation source, and the G-M tubes were enclosed in a Pb box. The reflected radiation increased as the depth of the solution in the dish increased to a saturation point, beyond which point it did not change. The length of exposure was long enough to allow the registering of about 40,000 impulses/sample. Each sample was also tested by potentiometric titration with 0.1 N $AgNO_3$. Results of the 2 methods varied from −0.63 to +2.65%. (auth)

39093 NONDESTRUCTIVE DETERMINATION OF INDIUM IN INTERMETALLIC ALLOYS BY MEANS OF NEUTRON ACTIVATION ANALYSIS, USING Po + Be AS THE NEUTRON SOURCE. J. Toelgyessy. Chem. Zvesti, 18: 48-54(1964). (In Slovak)

A 7-C Po + Be neutron source with a flux of 1.4×10^7 n/cm^2/sec was used. Paraffin was used as the moderator of fast neutrons. The flow of slow neutrons (with 45-mm thick paraffin) was 10^3 to 10^4 n/cm^2/sec. When the neutron source was not in use, it was kept in a tube, above the working setup, surrounded by 22 cm of water on all sides. The optimal distance between the examined sample and the source was 45 mm. The space between the sample and the source was filled with 0.5- to 1-cm thick paraffin disks. Samples weighing 18–22 mg were irradiated for 60 min and their activities were measured 10 min after the irradiation. The In content was read from a calibration curve. By using this method, the In can be determined in mg amounts relatively accurately and simply. Greater accuracy could be achieved by using a stronger neutron source and larger samples. The As and Sb, which were present in the intermetallic alloys examined, did not interfere with the determinations. This method, which is suitable for serial testing, has the disadvantage, that the slow neutron flow from the neutron sources used will cause activity even in elements with a high effective activity cross section. (OID)

39094 THE DETERMINATION OF Sr^{90} IN FALLOUT AND IN SURFACE WATERS. L. Argiero, S. Manfredini, and G. Palmas (CAMEN, Livorno, Italy). Chim. Ind. (Milan), 43: 896(1961). (In Italian)

Two methods are described for the determination of ^{90}Sr in fallout and surface waters. Recoveries of ^{90}Sr are within 70–75% in both methods. (P.C.H.)

39095 CHEMICAL EFFECTS OF ISOMETRIC TRANSITIONS: THE SEPARATION OF TELLURIUM ISOMERS IN DIFFERENT CHEMICAL MEDIA. Richard L. Hahn (Oak Ridge National Lab., Tenn.). J. Chem. Phys., 41: 1986-90 (Oct. 1, 1964).

The chemical separation of the nuclear isomers of ^{127}Te and ^{129}Te in different media was studied. The variation of $f_j(^{127}\text{Te})$ with pH in aqueous solutions of HCl, HNO_3, $HClO_4$, and NaOH was measured; f_j is the probability that, if the parent metastable-state activity is in the telluric acid form, the daughter ground-state activity will be found as tellurous acid as a result of chemical interactions in a medium of substance j. The f_j's for the different acids behave very similarly as the pH changes. In 6N acid solutions, f_j is close to unity; it decreases monotonically with increasing pH and approaches the value for H_2O, at pH of 6.0, of 0.760 ± 0.017. In NaOH, f_j increases with decreasing pH, and also approaches the value for H_2O. The variations of f_j with pH may be expressed by the relation, $f_j = \exp(x_j)/[1 + \exp(x_j)]$, with $x_j = m_j(\text{pH}) + b_j$; m_j and b_j are parameters that were obtained from the data. Also, relative f_j values for ^{127}Te and ^{129}Te were determined in solid telluric acid, H_2O, and 6N solutions of HCl, $HClO_4$, and NaOH. Although the absolute f_j values for these nuclides change from substance to substance, the ratios of the f_j's remain fairly constant, approximately equal to unity. Thus, f_j appears to be mainly a function of the chemical, and not the nuclear, properties of the isomer separation process. (auth)

39096 REVERSED-PHASE CHROMATOGRAPHY OF ALKALINE EARTHS ON PAPER TREATED WITH DI-(2-ETHYLHEXYL) ORTHOPHOSPHORIC ACID IN CHLORIDE MEDIUM. E. Cerrai and G. Ghersini (Laboratori C.I.S.E., Segrate, Milan). J. Chromatog., 15: 236-45(July 1964).

Reversed-phase chromatography of alkaline earth metals on paper treated with di-(2-ethylhexyl) orthophosphoric acid (HDEHP) was investigated, using hydrochloric acid as eluent in a range of concentrations from 10 to 1.10^{-4} M. The quantity $(1/R_F - 1)$ was related to the hydrogen ion concentration in the mobile phase, and to the effective HDEHP concentration on the paper. The chromatographic behavior was correlated with that of liquid-liquid extraction systems. Chromatographic separations of alkaline earths from each other, and from other cations, were performed. Two of them were obtained with acetic acid elutions. (auth)

39097 DETERMINATION OF MOISTURE CONTENT OF LACTOSE BY NEUTRON THERMALIZATION. Garnet E. Peck (Mead Johnson, Evansville, Ind.), John E. Christian, and Gilbert S. Banker. J. Pharm. Sci., 53: 632-5(June 1964).

A new method for moisture measurements is described that depends on the moderation of fast neutrons by the H atoms of water, producing slow or thermal neutrons which are detectable by a boron trifluoride detector. The number of slow neutrons resulting from the moderation is directly proportional to the number of H atoms in the sample. The density of the material would determine the amount of H atoms observed by the neutron source per unit volume, so that it is necessary to observe the relative density. The amount of absorption and backscattering of γ rays by the outer electrons of the atoms in a given sample is a measure of the material's density, and the amount of backscattering is inversely proportional to the density. Thus a γ source was used to observe any large changes in sample density. The probe consisted of a Ra–Be source, detector, and preamplifier. The neutron output of the source was 6.78×10^4 neutrons/sec. A boron trifluoride slow-neutron detector is used in the probe, connected to the scaler with a cable. The density probe consisted of a γ source (2.83 mC ^{137}Cs), detector (three GM tubes), and a preamplifier. This procedure and apparatus were developed from commercially available equipment designed for depth moisture determinations of soils. The moisture content of three series of water levels in lactose U.S.P. was determined at various concentration levels by the neutron method and by two official methods (gravimetric and Karl Fischer titration). Calibration curves for the moisture determination of lactose were prepared by plotting the slow-neutron count vs. the moisture determined for these two methods. Applications of the method in the analysis of bulk chemicals for moisture content are discussed. (C.H.)

39098 DETERMINATION OF ZINC IN IRON METEORITES BY NEUTRON ACTIVATION ANALYSIS. Hiroshi Hamaguchi (Tokyo Kyoiku Univ.), Ryuitiro Sugisita, Masazumi Kawai, and Naoki Onuma. Japan Analyst, 13: 735-8 (Aug. 1964). (In Chinese)

The determination of a trace amount of zinc in some iron meteorites was made by neutron activation analysis using short-lived 52-min ^{69}Zn. Samples and a standard were irradiated simultaneously for 20 minutes in the JRR-1 reactor at the neutron flux of 3×10^{11} n/cm^2/sec. After irradiation the sample was dissolved in a HNO_3–HCl–H_2SO_4 mixture in the presence of zinc carrier. The induced activity derived from zinc was separated and purified from the matrix by acetyl acetone–chloroform and isopropyl ether extractions, followed by an anion-exchange procedure. Finally zinc was precipitated as zinc mercury thiocyanate, and the β activity of the purified isotope ^{69}Zn was counted. The concentration of zinc in the sample was calculated by comparing the activity of radiochemically pure ^{69}Zn isolated from the sample with that from the standard. The total time required for the completion of the whole procedure was three hours and a half, and the average chemical yield was 70%. (auth)

39099 STUDIES ON THE ACCURACY OF THE SCINTILLATION-SPECTROMETRIC METHOD ACCORDING TO LE GALLIC FOR THE IDENTIFICATION OF BETA-PARTICLE EMITTERS. N. Nasser and H.-W. Thuemmel (Institut für Angewandte Radioaktivität, Leipzig). Kernenergie, 7: 527-31(June-July 1964). (In German)

The method of Le Gallic, et al., (Intern. J. Appl. Radiation Isotopes, 11: 9 (1961) for identifying beta emitters by linear extrapolation of the integral beta spectra up to its point of intersection with the energy axis produced different results if different instruments or operating modes were employed. An improvement in the accuracy and reproducibility of this method was effected by employing the square root of the integral beta energy spectrum, rather than the actual value of the function, and by employing linear extrapolation. The accuracy of the method increased from approximately 10% error to approximately 3 to 5%, depending on the Mev range involved. The characteristics of the apparatus did not affect the results if the Mev range for the maximum energy was above 0.5. The technique requires about 50% more time than the original Le Gallic method. (M.C.G.)

39100 A SPECTROMETRIC METHOD OF DETERMINING THE ACTIVITY OF LOW-ENERGY BETA-EMITTERS WITH A LIQUID SCINTILLATION COUNTER. G. Wangermann (Institut für Angewandte Radioaktivität, Leipzig). Kernenergie, 7: 531-4(June-July 1964). (In German)

A method is described for the calculation of the characteristic Fermi-Curie curves from the values observed in the individual scintillation geometries. Energy calibration was accomplished with the aid of continuous beta spectra. Following energy calibration, the differential pulse magnitude distribution was integrated with a discriminator up to a limit above which the probability of errors caused by nonlinearities in light quantum yield and after pulses was negligible. After having applied appropriate corrections for the low-energy portion not included in the differential, all data became available for the calculation of the total activity. An equation was derived for effecting this calculation. A table developed for comparing the activity of a sample of benzoic acid labeled with ^{14}C evaluated by this method to results obtained with other methods is presented. (M.C.G.)

39101 APPARATIVE CORRECTIONS IN THE ABSOLUTE CALIBRATION OF RADIOACTIVE SUBSTANCES BY THE 4π BETA-GAMMA COINCIDENCE METHOD. M. Leistner (Institut für Angewandte Radioaktivität, Leipzig). Kernenergie, 7: 534-8(June-July 1964). (In German)

Means for correcting the inherent instrumental errors in the absolute calibration of radioactive materials according to the 4π beta-gamma coincidence method were investigated. Such errors are caused by dead-time values for the coincidence rate and by losses in coincidence recording. Apparative means for reducing these errors are discussed and equations derived for the calculation of these errors from appropriate instrument parameters and testing con-

dition data. Techniques for verifying these data are described. (OTS)

39102 ABSOLUTE ACTIVITY DETERMINATION OF TRITIATED WATER BY MEANS OF A PROPORTIONAL COUNTER. D. Modes and H. Koch (Institut für Angewandte Radioaktivität, Leipzig). Kernenergie, 7: 538-40(June-July 1964). (In German)

An absolute determination was made of the activity of tritiated water using the sealed tube technique in which the sample is reduced to hydrogen in a pressurized reaction vessel with zinc, the hydrogen mixed with a counting gas such as propane, and the partial hydrogen pressure determined directly in the proportional counting tube. The method is not affected by differences in specific activity and is accurate for routine applications. The apparatus employed, methods of operation, potential applications of the technique, and comparative accuracy figures vs. the microcalorimetric method are discussed. (OTS)

39103 DETERMINATION OF IMPURITIES IN SELENIUM BY ACTIVATION ANALYSIS. W. Roehnsch (Institut für Angewandte Radioaktivität, Leipzig). Kernenergie, 7: 543-5(June-July 1964). (In German)

Traces of As, Sb, Te, Ga, In, Tl, Cu, Cd, Hg, and Fe were determined by means of neutron activation analysis. The radioisotopes obtained by means of (n,γ) reactions were employed for the analysis. Irradiation was accomplished in the fission zone of the reactor at Rossendorf at a thermal neutron flux of approximately 9×10^{12} n/cm^2 sec. A detailed flow sheet for conducting the analysis is presented and the individual techniques are described. Interference in the determination of As by Se(n,p)As and its elimination are discussed. (M.C.G.)

39104 A SIMPLE TECHNIQUE FOR THE DETECTION OF INCORPORATED TRITIUM IN THE HUMAN BODY WATER. H. Langer and H.-K. Bothe (Institut für Angewandte Radioaktivität, Leipzig). Kernenergie, 7: 546-50(June-July 1964). (In German)

The presence of incorporated tritium in body fluids is measured by evaporating the moisture present in exhaled breath within an ionization chamber. The apparatus employed, experimental techniques, and accuracies of determination are discussed. A table from which the presence of incorporated tritium in other compounds than water could be postulated from the data on the specific activity of the body fluids is presented. The influence of inactive water in the inhaled air on the results and there accuracy was examined. (M.C.G.)

39105 USE OF NEUTRONS FOR CONTINUOUS DETERMINATION OF MOISTURE CONTENT IN FINE-GRAINED CONCRETE SAND. H. Cermak (Institut für Baustoffe, der Deutschen Bauakademie, Weimar, Ger.). Kernenergie, 7: 557-60(June-July 1964). (In German)

The technical and economic factors involved in the continuous determination of moisture in fine-grained concrete sand were investigated. The moisture sensor employs a Pu–Be neutron source. Coupled with a recorder, it was fitted to the outflow of a sand silo. Determinations accurate to within +1% could be made in the 2 to 12 moisture-% range. It was considered that the accuracy could be further increased with a more suitable outflow spout design. (OTS)

39106 THE INFLUENCE OF SOIL DENSITY ON RADIOMETRIC DETERMINATIONS OF THE MOISTURE CONTENT IN SOIL. K. Unger and St. Claus. Kernenergie, 7: 567-70(June-July 1964). (In German)

The effects of soil density on the accuracy and feasibility of radiometric moisture determination were investigated by measuring gamma radiation scattering and neutron reflection. The studies indicated that the anomalous gamma scattering, observed in the soil samples investigated, could form the basis of a radiometric moisture determination technique for soils. The effects of soil density on moisture determination are presented in the form of curves. (OTS)

39107 SPECTROPHOTOMETRIC DETERMINATION OF MICRO-AMOUNTS OF URANIUM WITH DIBENZOYLMETHANE. Laszlo Bakos and Laszlo Andras. Magy. Tud. Akad. Kozp. Fiz. Kut. Int. Kozlemen., 12: 235-40 (1964). (In Hungarian)

Experiments were made on U determination with dibenzoylmethane reagent. It was found that in the simultaneous presence of acidic and neutral organic phosphorus compounds the compounds of iron interfere with the determination. This disturbing effect can be eliminated by means of Complexon III. The difference between given values and mean values of U concentration as determined does not exceed ±3% in the concentration range from 30 to 3000 μg/5ml. In the concentration range below 30 μg/5 ml the deviation is higher than ±15%. (auth)

39108 PLUTONIUM IN THE MARINE ENVIRONMENT. K. C. Pillai, R. C. Smith, and T. R. Folsom (Univ. of California, San Diego, La Jolla). Nature, 203: 568-71 (Aug. 8, 1964).

The significance of Pu in the marine environment and the application of concentrating organisms for trace-element detection are discussed. Preliminary findings concerning the plutonium content in sea water and the concentration factors for this element in certain selected marine organisms are summarized. Alpha particles in the 4 to 6 Mev range were recorded. It was concluded that Pu is measurable in a marine environment, and a start was made toward establishing contemporary concentration levels of ^{239}Pu in marine organisms. (H.M.G.)

39109 ANALYSES OF RADIONUCLIDES OF BIOLOGICAL INTEREST IN PACIFIC WATERS. D. Chakravarti, G. B. Lewis, R. F. Palumbo, and A. H. Seymour (Univ. of Washington, Seattle). Nature, 203: 571-3(Aug. 8, 1964).

Methods for analyzing radionuclides in sea water and results of such analyses in Pacific waters are presented. Gamma-emitting isotopes were determined in samples of surface water after filtration or centrifugation and chemical separation, accomplished either by a hydroxide precipitation or a sulfide method. The gamma-counting system included a solid NaI(Tl) crystal in conjunction with a 512-Nuclear Data 120 analyzer. Calculations were carried out on a digital computer programmed to analyze for nine isotopes (^{51}Cr, ^{65}Zn, ^{95}Zr–^{95}Nb, ^{103}Ru, ^{141}Ce, ^{144}Ce, ^{137}Cs, and ^{60}Co) and to express results in picocuries per g at the time of collection. Geiger-Mueller counters were used for determining ^{90}Y and ^{32}P. Average and maximum values of radionuclides in sea-water samples are tabulated. (H.M.G.)

39110 DETERMINING Th^{230} IN THORIUM. Leslie C. Nelson and Harvey Bussell (Atomic Energy Commission, New Brunswick, N. J.). Nucleonics, 22: No. 9, 77(Sept. 1964).

A method for determining ^{230}Th in thorium is described, involving simultaneous measurement of the alpha activities of ^{230}Th and ^{232}Th with a solid-state alpha detector. (D.C.W.)

39111 GAMMA SPECTROMETRY OF AIR, FOODS, AND DRINK. E. Lanzola, E. Petrozzi, and A. M. Spina (Università, Rome). Nuovi Ann. Ag. Microbiol., 12: 386-95(Sept.-Oct. 1961). (In Italian)

Some expedient laboratory methods are described, which simplify the procedure and reduce time and labor, when utilizing rather cheap equipment. (auth)

39112 A METHOD FOR THE DETERMINATION OF STRONTIUM-90 STABLE STRONTIUM AND CALCIUM IN SOIL-VEGETATION COVER SAMPLES. F. I. Pavlotskaya, G. A. Fedoseev, E. V. Babicheva, L. N. Zatsepina, and E. A. Tiuriukanova. Pochvovedenie, No. 2, 105-12(1964). (In Russian)

A simplified method for the determination of strontium-90, stable strontium, and calcium contents in soil-vegetation cover is proposed. The method is based on a direct strontium determination in the presence of calcium by flame spectrometry. Description of the procedure is given. (auth)

39113 DETECTION AND COMPUTATION OF ISOTOPE FRACTIONATION IN THE ADSORPTION CHROMATOGRAPHY OF DUAL-LABELLED COMPOUNDS. P. D. Klein, D. W. Simborg, and Patricia A. Szczepanik (Argonne National Lab., Ill.). Pure Appl. Chem., 8: 357-70(1964).

Studies were made on isotope fractionation during adsorption chromatography of dual-labeled cholesterol acetates, calculation of isotope fractionation in chromatographic processes involving dual-labeled compounds, and the relation of isotope fractionation to compound structure and isotope location. The results showed that isotopic fractionation occurs during the chromatography of compounds labeled with tritium and ^{14}C. It is shown that easily recognizable sources of artefacts can be ruled out under these circumstances; while the possibility of more exotic sources cannot be excluded, the reproducibility of the phenomenon and its appearance in a variety of situations makes this possibility appear quite small. Evidence for this is the fact that three forms of computation all yield significant and similar values for the displacement of ^{3}H from ^{14}C in each instance. The experiments also indicate the necessity for caution in the use and interpretation of doubly-labeled tracer systems, particularly when a chemical component is subjected to purification in a system with good resolution. (P.C.H.)

39114 EXTRACTION OF RUTHENIUM BY NAPHTHOLS FROM FISSION PRODUCTS MIXTURES. Ctirad Konečný (Nuclear Research Inst., Czechoslovak Academy of Sciences, Řež). Radiochim. Acta, 2: 188-92(July 1964).

Separation of microamounts of ruthenium from fission product mixtures in 0.2–0.8 M-HNO_3 by extraction with molten naphthols was studied with respect to the composition of individual mixtures and to naphthol amounts. The values of ruthenium distribution ratios depend on the molar ratios naphthol : ferric ions and naphthol : mercuric ions. The radionuclides ^{106}Ru, ^{90}Sr, ^{144}Ce, and ^{137}Cs were used for the test trials. (auth)

39115 EXTRACTION OF MICROAMOUNTS OF RUTHENIUM IN THE PRESENCE OF FERRIC IONS. Ctirad Konečný (Nuclear Research Inst., Czechoslovak Academy of Sciences, Řež). Radiochim. Acta, 2: 192-7(July 1964).

The influence of ferric ions on the extraction of microamounts of ruthenium by molten 1-naphthol from dilute nitric acid media was investigated. It was found that these ions influence unfavorably the extraction of ruthenium by oxidizing the naphthol to insoluble α-dinaphthol, which causes a decrease in the amount of naphthol available for ruthenium extraction. (auth)

39116 SEPARATION OF ZIRCONIUM-95 FROM NIOBIUM-95 BY EXTRACTION WITH A BENZENE SOLUTION OF FATTY ACIDS IN THE PRESENCE OF HYDROGEN. M. Kyrš (Nuclear Research Inst., Czechoslovak Academy of Sciences, Řež). Radiochim. Acta, 2: 202-3 (July 1964).

Zirconium was extracted at pH ~6 in presence of 10^{-3} M H_2O_2 with a benzene solution of fatty acids (C_7–C_9; 1 M). Niobium was masked by hydrogen peroxide. Coextraction of niobium with zirconium in weighable amounts was observed. (auth)

39117 SPECTROMETRIC ANALYSIS OF ^{95}Zr–^{95}Nb MIXTURES BY BETA AND GAMMA SCINTILLATION. A. Guillon, M. Colonomos, and R. Sauvagnac (Commissariat a l'Energie Atomique, Saclay, France). Radiochem. Acta, 2: 213-15(July 1964). (In French)

A routine method for the successive measurement of the sum of ^{95}Zr–^{95}Nb activities by γ spectrometry and of ^{95}Zr activity by β spectrometry with a plastic scintillator is proposed. The activities are determined by comparison to a known standard mixture. The method dispenses with the use of standard sources of the pure radioelements. The interference by ^{95}Nb and ^{95m}Nb in the ^{95}Zr analysis was measured. Precision and threshold of the detection of one of the elements in the other are given. One complete analysis (two determinations) takes less than 4 hours. (auth)

39118 COUNTING LOSSES IN COUNTING OF METALLIC ISOTOPES IN LIQUID SCINTILLATORS. Gerhard Erdtmann, Universitat, Mainz). Radiochim. Acta, 2: 215-17 (July 1964). (In German)

The counting rates of liquid scintillation samples containing salts of metals will drop within a short time because radioactive atoms are adsorbed on the counting vial. Counting losses are observed also with scintillation solutions containing complexing agent. They may be avoided by adding carrier to the nuclide or highly dispersed silicon dioxide to the scintillator. Carrier will interfere if colored or if insoluble compounds may be built up. (auth)

39119 GAMMA SPECTROMETRIC DETERMINATION OF THE ^{199}Au TO ^{198}Au RATIO IN PILE IRRADIATED GOLD TARGETS. M. A. El Guebeily, A. A. Abdel Rassoul, and H. Fouad (Atomic Energy Establishment, [Cairo]). Radiochim. Acta, 2: 217-18(July 1964).

Studies were made on the accuracy of the gamma spectrometric method for the determination of the ^{199}Au to ^{198}Au ratio and to check the published value of the cross section of the $^{198}Au(n,\gamma)$ process for thermal neutrons. It was concluded that in routinely produced radiogold samples, which are normally used for medical purposes, the ^{199}Au to ^{198}Au ratio can be determined by means of the gamma spectrometric technique with an accuracy of 5% or better. It was also proved that the value of 26000 barns for the cross section for neutron capture in ^{198}Au is correct within a few percent. (P.C.H.)

39120 THE ANALYSIS OF INORGANIC SUBSTANCES BY RADIOACTIVATION ON CHROMATOGRAPHIC PAPER. II. THORIUM AND RARE EARTHS. Tiberiu Nascutiu (Inst. for Atomic Physics, Bucharest). Rev. Roumaine Chim., 9: 283-7(Apr. 1964).

The possibility of quantitative determination of thorium and rare earths directly by a method of radioactivation on paper, after a previous chromatographic separation, was studied. For sub-microgram amounts the errors of analysis do not surpass ±12%. (auth)

39121 FAST-NEUTRON-ACTIVATION ANALYSIS FOR DETERMINATION OF COPPER CONTENT OF LOWER SILESIAN COPPER DEPOSITS. Ludwik Górski (Inst. of Radioisotope Techniques, Academy of Mining and Metallurgy, Krakow), Wlodzimierz Kusch, and Jolanta Wojtkowska. Talanta, 11: 1135-42(Aug. 1964).

The feasibility of determining copper in copper ores by means of activation with 14-Mev neutrons was investigated. In the method the $^{63}Cu(n,2n)^{62}Cu$ reaction and a coincidence measurement of the gamma radiation from the annihilation of positrons from the decay of ^{62}Cu is used. The relative error is of the order of 2%, and the mean time needed for a single determination is of the order of 4 min. The influence of other positron-emitting elements contained in the ore was studied theoretically; it results in an average overestimate of the copper content of about 0.05%. The method can be applied with advantage when the demand for analyses is a few hundred per day. (auth)

39122 A NEW PRINCIPLE OF ACTIVATION-ANALYSIS SEPARATIONS. VII. SUBSTOICHIOMETRIC DETERMINATION OF TRACES OF ARSENIC. Adolf Zeman, Jaromír Růžička, Jiří Starý, and Eva Klečková (Dept. of Nuclear Chemistry, Faculty of Technical and Nuclear Physics, Prague). Talanta, 11: 1143-9(Aug. 1964).

The radiochemical procedure is based on the solvent extraction of arsenic(III) diethyldithiocarbamate into chloroform from 2-3 M hydrochloric acid, and eliminates the necessity of determining the chemical yield. Moreover, using a substoichiometric amount of reagent (zinc diethyldithiocarbamate in chloroform), the separation of arsenic becomes very selective. When the dissolved irradiated sample is first extracted with diethylammonium diethyldithiocarbamate (arsenic present in quinquevalent form), only antimony and tin subsequently interfere. This interference can be completely eliminated by a cupferron extraction performed after reduction of both arsenic and antimony to the tervalent state. The procedure developed is far more simple and rapid than previously described radiochemical separations for arsenic. It was used for the determination of arsenic in pure silicon semiconductor material (down to 10^{-6} %) and can undoubtedly be used with little adaptation for the determination of arsenic in various other materials. (auth)

39123 A NEW PRINCIPLE OF ACTIVATION-ANALYSIS SEPARATIONS. VIII. SUBSTOICHIOMETRIC DETERMINATION OF TRACES OF ANTIMONY. Jaromír Růžička, Jiří Starý, and Adolf Zeman (Dept. of Nuclear Chemistry, Faculty of Technical and Nuclear Physics, Prague). Talanta, 11: 1151-6(Aug. 1964).

A highly selective, very simple substoichiometric separation of antimony from an irradiated test sample was developed. After irradiation, isotopic carrier for antimony is added and the test sample dissolved under oxidizing conditions. To the acid solution (2M sulfuric acid) cupferron is added in excess and the resulting cupferrates, except for those of antimony(v) and arsenic(v), extracted with chloroform. After reduction of antimony(v) (and arsenic(v)) to the tervalent state, it is precipitated using a substoichiometric amount of cupferron at pH 2-3 and selectively extracted with chloroform. A simultaneously irradiated standard sample of antimony is treated in exactly the same way. As in other substoichiometric determinations the necessity of determining the chemical yield is avoided. The utility of the method was verified by the determination of antimony (down to 10^{-8}%) in pure silicon semi-conductor material. Because of its high selectivity, the method may also prove useful for determining traces of antimony in various other materials. (auth)

39124 ANION EXCHANGE BEHAVIOUR OF URANIUM, THORIUM, THE RARE EARTHS AND VARIOUS OTHER ELEMENTS IN HYDROCHLORIC ACID-ORGANIC SOLVENT MEDIA. J. Korkisch and I. Hazan (Universität, Vienna). Talanta, 11: 1157-75(Aug. 1964).

The anion-exchange behavior of uranium, thorium, the rare earths, and several other elements representing various groups of the Periodic Table, was investigated in 12 organic solvents containing hydrochloric acid as the complexing agent. Based on the determination of the distribution coefficients of these elements in such media, possible separation methods are indicated and discussed. The relationship between the dielectric constants of the applied solvents and the adsorption behavior of the elements is also described. 140 references are included. (auth)

39125 CONTRIBUTIONS TO THE BASIC PROBLEMS OF COMPLEXOMETRY. XIV. DETERMINATION OF ZIRCONIUM, THORIUM AND TITANIUM IN THE PRESENCE OF EACH OTHER. Rudolf Přibil and Vladimír Veselý (Polarographic Inst., Czechoslovak Academy of Sciences, Prague). Talanta, 11: 1197-1202(Aug. 1964).

The complexometric determination of zirconium, thorium, and titanium in their mixtures is described. These elements can be separated from many others by precipitation with sodium hydroxide in the presence of triethanolamine. It was found that precipitated zirconium hydroxide has a polymeric structure, which is not destroyed by dissolving the hydroxide in nitric acid. This leads to low results for zirconium. The depolymerisation of the zirconium polymer in different acids was thoroughly studied and conditions for the reliable complexometric determination of zirconium are described. (auth)

39126 A RAPID AND SPECIFIC TITRIMETRIC METHOD FOR THE PRECISE DETERMINATION OF URANIUM USING IRON(II) SULPHATE AS REDUCTANT. W. Davies and W. Gray (Dounreay Experimental Reactor Establishment, Caithness, Scotland). Talanta, 11: 1203-11(Aug. 1964). (TRG-Report-716)

A procedure was evolved that enables uranium to be determined without chemical separation in solutions containing iron, plutonium, nitrate, and many other foreign ions, which interfere in conventional redox methods. All of the operations needed are carried out in one vessel, in the cold. An excess of iron(II) sulfate is employed to reduce uranium(VI) to uranium(IV) in a concentrated phosphoric acid solution containing sulfamic acid. The excess of iron(II) is subsequently oxidized by nitric acid in the presence of molybdenum(VI) as catalyst. After adding sulfuric acid and diluting the mixture with water, the determination is completed by titration with standard potassium dichromate solution in the usual manner, using barium diphenylamine sulfonate as indicator. (auth)

39127 INDIRECT COMPLEXOMETRIC DETERMINATION OF PHOSPHATE IONS BY PRECIPITATION WITH ZIRCONIUM IONS. O. Budevsky, L. Pencheva, R. Russinova, and E. Russeva (Inst. of General and Inorganic Chemistry, Sofia). Talanta, 11: 1225-9(Aug. 1964).

A highly selective indirect complexometric determination of phosphate ions is proposed. The method is based on precipitation of the phosphate ions with a known quantity of zirconium ions and complexometric titration of the zirconium excess. Both the precipitation and the titration are carried out in a strongly acidic medium, so ensuring a

high selectivity for the determination. The method was applied for the analysis of natural phosphorites. (auth)

39128 DETERMINATION OF SCANDIUM, YTTRIUM, SAMARIUM AND LANTHANUM IN STANDARD SILICATE ROCKS, G-1 AND W-1, BY NEUTRON-ACTIVATION ANALYSIS. H. B. Desai, R. Krishnamoorthy Iyer, and M. Sankar Das (Atomic Energy Establishment, Trombay, India). Talanta, 11: 1249-55(Aug. 1964).

Neutron-activation analysis results for four rare earth elements in standard silicate rocks, G-1 and W-1, are reported. An anion-exchange method for the separation of scandium, yttrium, samarium, and lanthanum in good radiochemical purity was developed. The method is based on the chromatographic elution of these elements from a Dowex 1 × 8 (nitrate form) resin column using methanol-nitric acid mixtures. The results obtained by this method were compared with values already available. (auth)

39129 DETERMINATION OF HAFNIUM CONTENT AND Hf/Zr RATIOS IN ZIRCON WITH THE DIRECT-READING EMISSION SPECTROMETER. Claude L. Waring. U. S. Geol. Surv. Profess. Papers, No. 501, B146-7 (1964).

Hafnium content and Hf/Zr ratios in zircons were determined with the direct-reading emission spectrometer using a 1-mg sample in a d-c arc with a controlled atmosphere. The precision for the determination of hafnium and of the ratios is excellent, and the ratios agree well with similar determinations by x-ray fluorescence. (auth)

39130 A SPECTROGRAPHIC METHOD FOR THE DETERMINATION OF CESIUM, RUBIDIUM, AND LITHIUM IN TEKTITES. Charles Annell. U. S. Geol. Surv. Profess. Papers, No. 501, B148-51(1964).

Spectrographic determinations of cesium, rubidium, and lithium in tektites, in concentrations as low as 1 ppm, were made with a K_2CO_3 = sample mixture and a 15-amp d-c arc. Selective filtering at the focal plane permits measurable line intensities for the two exposure conditions required. (auth)

39131 HOW TO DETERMINE THE LEVEL OF RADIOACTIVE STRONTIUM IN WATER. G. B. Morgan, E. H. Galbraith, and F. W. Gilcreas (Univ. of Florida, Gainesville). Water Works Eng., 116: 33; 53(Jan. 1963).

The column chromatographic method for the determination of total radioactive Sr is described. Although the method is primarily for water supplies it can be used for other types of samples, the only requirement being that the sample must be in solution. Strontium is separated from Ca by ion exchange and ^{140}Ba can be removed by precipitation. The entire analysis extends over several hours but the actual personnel time required averages less than 30 min per sample. (P.C.H.)

39132 GAS RADIOCHROMATOGRAPHY OF ^{14}C- AND ^{11}C-LABELED ALIPHATIC CARBOHYDRATES AND AMINES. G. Stoecklin, F. Cacace, and A. P. Wolf (Brookhaven National Lab., Upton, N. Y.). Z. Anal. Chem., 194: 406-16(1963). (In German)

Techniques, instrumentation, specific examples, and problems encountered in gas radiochromatography employing ^{14}C and ^{11}C are outlined. Sources of error are delineated and proposals for improved techniques are made. Marked changes of flow rate (and hence efficiency changes of a continuous flow counter), which occur after the injection of large gas samples, were studied as functions of the variables involved. A new flow meter is described which allows a continuous recording of the flow rate, independent of the viscosity of the gas. When a mass peak emerges from a gas chromatographic column, a relatively large change in the flow rate is likely to occur. The error involved is particularly serious in the cases when the radioactivity of the effluent gases is determined with a flow counter whose efficiency depends upon the flow rate. The simple and highly precise flow meter described allows measurement and therefore correction for the flow changes. A convenient and precise evaluation of the radioactivity in the peak of the gas chromatographic effluent by a digital printout system is described. An application of the improved gas radiochromatographic technique is given for the analysis of ^{11}C- and ^{14}C-recoil products in simple gaseous aliphatic hydrocarbons and amines. As a flow counter a proportional window (4π Sandwich-type) is used, the nonstatic efficiency of which is given for ^{11}C and ^{14}C. With the technique and apparatus described, at least 10^{11} molecules of ^{14}C-labeled compound in each peak are required compared with only 5×10^3 for ^{11}C-labeled compounds. (BBB)

39133 USE OF BENTONE CONTAINING SEPARATION COLUMNS FOR THE GAS CHROMATOGRAPHY OF POLYPHENYL MIXTURES. B. Versino, F. Geiss, and G. Barbero (EURATOM, Ispra, Italy). Z. Anal. Chem., 201: No. 1, 20-9(1964). (EUR-1653.d). (In German)

The general utility of modified Bentone-columns for the separation of aromatic hydrocarbons, especially of polyphenyls, is shown. The separation results were compared with those obtained on solid cesium chloride phases which guarantee an almost unlimited duration of life, even up to 500°C. Mixtures of brominated bi- and terphenyls figure as examples for the separation of substituted aromatics. Packed columns were used exclusively. (auth)

39134 A REACTION-RADIOGAS CHROMATOGRAPH FOR ANALYSIS OF HIGH-BOILING NITROGEN- AND SULFUR-CONTAINING ORGANIC COMPOUNDS OF LOW SPECIFIC ^{14}C- OR ^{11}C-ACTIVITY. Bodo Diehn, A. P. Wolf, and F. S. Rowland (Brookhaven National Lab., Upton, N. Y. and Univ. of Kansas, Lawrence). Z. Anal. Chem., 204: 112-17(1964). (In German) (BNL-7580)

A radio-gas chromatograph for the determination of ^{14}C or ^{11}C in organic substances by continuous combustion of the column effluents and internal proportional flow counting of the resulting CO_2 at room temperature is described. Water, SO_2, and NO_2 are continuously removed by absorption. The method is particularly suitable for the analysis of high boiling compounds and avoids the problems associated with heated counters. The use of Co_3O_4 as combustion catalyst makes accurate temperature control of the combustion furnace unnecessary. Completeness of combustion and absorption and constancy of counter efficiency under varying conditions are demonstrated. (auth)

39135 STUDIES WITH AN X-RAY FLUORESCENCE SPECTRAL ANALYSIS APPARATUS ON THE MICRO SCALE. Karl Heinz Grothe and Werner Fischer (Technische Hochschule, Hanover). Z. Anal. Chem., 204: 161-72(1964). (In German)

Investigations were carried out in order to determine some rare earths and yttrium with a special x-ray fluorescence equipment, which consists of a spectrometer of advantageous resolution combined with an x-ray tube that permits a strong fluorescence excitation of a few milligrams of substance within the tube. Since the absolute intensity of the fluorescence lines depends on apparative conditions that are not reproducible the method of internal standard was applied for quantitative determinations. Calibration curves are discussed for the mixtures of Y_2O_3–

ZrO_2 and $Nd_2O_3-Pr_6O_{11}$ in a concentration range of 10–80 wt% Y_2O_3 and 4–97 wt% Nd_2O_3, respectively. Both the standard deviations of the intensity ratios and the deviations of the means of the ratios from the calibration curves were about 1%. (auth)

39136 DETERMINATION OF SMALL HAFNIUM CONTENTS IN ZIRCONIUM OXIDE BY NEUTRON ACTIVATION ANALYSIS. Karl Heinz Grothe and Klaus Reinhardt (Technische Hochschule, Hanover). Z. Anal. Chem., 204: 176-81 (1964). (In German)

A procedure is described for the determination of hafnium in zirconium oxide by neutron activation analysis. The special feature of the method is the use of low activities only. Therefore, no extensive precautions are required. The method is specially suitable for the determination of 10–100 ppm of HfO_2 in ZrO_2. The relative standard deviation is 5–10%. (auth)

39137 STUDIES IN RARE ISOPOLY MOLYBDATES. AMPEROMETRIC DETERMINATION OF ZIRCONIUM AS ZIRCONYL MOLYBDATE. C. M. Gupta (Rajasthan Univ., Jaipur, India). Z. Anal. Chem., 204: 181-3(1964).

The use of Na_2MoO_4 as a precipitant for the quantitative amperometric determination of zirconium ion as zirconyl molybdate in the pH range 5 to 6.5 is reported. In a series of determinations, the precision was better than 0.50%, with very dilute samples, however, it was poorer. The stronger solutions were handled after proper dilution. The method was not applicable in the presence of cations giving insoluble molybdates. (P.C.H.)

39138 ON THE SELECTION OF COMPLEXONOMETRIC INDICATORS FOR SCANDIUM FROM A SERIES OF AZO DERIVATIVES OF CHROMOTROPIC ACID. A. I. Cherkesov and N. M. Alykov (Saratov State Pedagogical Inst., USSR). Zh. Analit. Khim., 19: 943-6(1964). (In Russian)

Thirty-eight compounds, derivatives of chromotropic acid, were synthesized and their properties as indicators for scandium and some other elements were studied. It was found that stilbene-2,2′-disulfonic acid-4,4′-bis[(azo-2′)-1,8-dihydroxynaphthalene-3,6-disulfonic acid] is the best for the direct complexonometric titration of scandium. This reagent can be used for scandium titration by the artificial light. The titration is possible at pH 1.5 to 2.5 for 0.01 M solutions and at pH 4 to 5 for 0.001 M solutions of scandium. (auth)

39139 ANALYSIS OF ALLOYS OF RARE EARTHS WITH CERTAIN METALS AND OXIDES. T. N. Nazarchuk, O. I. Popova, L. N. Kugai, E. V. Dzerzhanovskaya, G. T. Kabannik, S. F. Boremskaya, and N. K. Chugunnaya (Inst. of Metalloceramics and Special Alloys, Kiev). Zh. Analit. Khim., 19: 980-4(1964). (In Russian)

A method for the complexonometric determination of elements in mixtures of La_2O_3-MgO, Sc_2O_3-MgO, and Y_2O_3-MgO was developed. The method is based on the titration of a rare earth and magnesium with complexone III at different acidities of the solution using different indicators. A method was also developed for the complexonometric analysis of mixtures of $Cr_2O_3-La_2O_3$ and $NiO-Sc_2O_3$ and for the determination of lanthanum, aluminum, and magnesium when they are present together in fluomicas. (auth)

39140 ANALYSIS OF TITANIUM AND THORIUM SULPHIDES. G. N. Dubrovskaya and I. N. Godovannaya (Inst. of Metalloceramics and Special Alloys, Kiev). Zh. Analit. Khim., 19: 993-6(1964). (In Russian)

A study was made of the oxidizability of titanium and thorium sulfides in an oxygen current. Satisfactory results were obtained when sulfur was determined in the above sulfides by the combustion method. (auth)

39141 POSSIBILITIES AND LIMITATIONS OF ANALYSIS BY THE METHOD OF β-RADIATION REFLECTION (A REVIEW). V. G. Gyglya (Inst. of Steel and Alloys, Moscow). Zh. Analit. Khim., 19: 1002-11(1964). (In Russian)

The method of β reflection for analysis is reviewed. The principles of the method are considered and the relationship between intensity of the reflected radiation and nature of the reflector, its chemical composition, is discussed. Results are given of the analysis of solutions, alloys, oxides, and ores of various metals. It is shown that in a number of cases the accuracy of the method is not less than that of chemical analysis. It can be used for solving a number of problems where rapidity is more important than accuracy. It permits the automation of analyses in the industry. The limitations and prospects of the method are discussed. (auth)

39142 ANALYTICAL CHEMISTRY OF NIOBIUM AND TANTALUM. Ross W. Moshier. New York, Pergamon Press Inc., 1964. 278p.

A study of Nb, Ta, and their compounds, detailing methods of separation and determination is presented. Included are new reagents, precipitation, solvent extraction, ion exchange and chromatography, volatilization, titrimetry, polarography, spectrophotometry, spectrography, and x rays. Methods of separation deal with minerals, alloys, solutions, and fission products. (auth)

39143 MASSENSPEKTROMETRIE. TEIL I. PHYSIKALISCHE UND APPARATIVE GRUNDLAGEN. TEIL II. ANWENDUNGEN. (Mass Spectrometry. Part I. Physics and Apparatus Fundamentals. Part II. Applications). C. Brunnee and H. Voshage. Munich, Verlag Karl Thiemig KG, 1964. 325p. DM 54.-.

The principles of mass spectrometry, mass separation, ion production, sample introduction, ion detection, and equipment are discussed. Uses of mass spectrometry for isotopic abundance determinations, precision mass determination, quantitative analysis, qualitative analysis, physical-chemical investigations, and investigations of the exchange effects of ions with materials are described. (M.C.G.)

39144 GUIDE TO ACTIVATION ANALYSIS. William S. Lyon, Jr., ed. (Oak Ridge National Lab., Tenn.). Princeton, N. J., D. Van Nostrand Co., Inc., 1964. 203p. $5.95 (D. Van Nostrand Co., Inc.).

This book presents, in logical and chronological fashion, information which is needed in an activation analysis program. The chapters treat respectively basic nuclear properties, reactor neutron flux, nonreactor neutron sources, radiochemical separations, radiation detection methods, and trends and examples of activation analysis. Calculated sensitivities and radiation safety and licensing requirements are also given. (D.L.C.)

39145 THE DETERMINATION OF BERYLLIUM. Handbook of Chemical and Radiometric Methods for its Determination in Ores, Concentrates and Low-grade Sources. (Gt. Brit. National Chemical Lab., Teddington, Middx., England). 1963. 36p. 3s (HMSO).

A review is presented on the chemical and radiometric methods for the determination of Be in ores, concentrates, and low-grade sources. Break-down of sample, determination methods, health-safety precautions, and radiometric assay are discussed. (P.C.H.)

39146 A NEW METHOD TO MEASURE RADON AND THORON IN FLOWING GASES AND ITS USE TO DETERMINE THE THORON-CONTENT OF ATMOSPHERIC AIR. W. Jacobi (Hahn-Meitner-Institut für Kernforschung, Berlin). 18p. (CONF-337-34)

From International Conference on Radio-Active Pollution of Gaseous Media, Saclay, France, Nov. 1963.

The double filter method for the measurement of low ^{222}Rn or ^{220}Rn concentrations in flowing gases is described. Using this method Rn can be controlled continuously down to concentrations below 100 pC/m^3. It allows the objection of thoron in gases in the presence of Rn down to concentrations of about 10 pC/m^3 and therefore for the first time a direct quantitative measurement of the thoron content in atmospheric air. Simultaneously with Rn or thoron their decay products can be determined by measurement of the primary filter-activity. The method joins high Rn- or thoron-sensitivity with simplicity and stability; the technical effort is low and only conventional filter counting techniques are required. (P.C.H.)

39147 SEPARATION AND MEASUREMENT OF RARE FISSION GASES BY GAS CHROMATOGRAPHY. P. Amadesi, A. Cervellati, and O. Rimondi. 20p. (CONF-337-39)

From International Conference on Radioactive Pollution of Gaseous Media, Saclay, France, Nov. 1963.

A method is described for the separation of Kr and Xe fission gases released by nuclear fuel under irradiation. Kr and Xe were separated from each other and from other components of a gaseous mixture by gas chromatography. From the results it was concluded that in the case of nuclear fuel irradiated by neutrons for several hours, it is possible to determine, with an error not above 10%, the quantities of rare fission gases released. (P.C.H.)

39148 CHARACTERISTICS OF ION-SENSITIVE EMULSIONS FOR MASS SPECTROGRAPHY. J. M. McCrea (U. S. Steel Corp., Monroeville, Penna.). 21p. (CONF-649-3)

From 12th Annual Conference on Mass Spectrometry and Applied Topics, Montreal, June 1964.

As part of a research program in spark-source solids mass spectrometry, the photon and ion response characteristics of various types of detector plates were determined. Outgassing behavior of the plates in high-vacuum service was also evaluated by empirical tests in a mass-spectrometer system. Conventional ion-sensitive plates were compared and contrasted on the basis of log-probability response curves. Various development procedures were classified by the nature of the response curves and by the extent of processing fog. Coating analyses and microstructure are related to the response properties of some emulsions. Development of an emulsion with much higher ion sensitivities than the present SWR and Q plates is forecast. (auth)

39149 MASS SPECTROMETRY AND THE PROPERTIES OF CONDENSED SYSTEMS AT HIGH TEMPERATURES. P. Breisacher (Aerospace Corp., El Segundo, Calif.). 64p. (CONF-649-4)

From 12th Annual Conference on Mass Spectrometry and Allied Topics, Montreal, June 1964.

A general discussion of the applicability of mass spectrometry toward the study of high temperature systems is given. Specific attention is given to the methods of ion generation, experimental techniques and interpretation of the results obtained. A summary of work performed in this area of investigation is given in tabular form. (auth)

Inorganic and Physical Chemistry

Refer also to abstract 39482.

39150 (AAEC/TM-240) THE COORDINATION OF BERYLLIUM WITH SALICYLIC ACID AND RELATED COMPOUNDS. J. Aggett and Cha-Duk Kim (Australia. Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales). Apr. 1964. 10p.

Complex formation between beryllium and the related ligands salicylic, 1-hydroxy 2-naphthoic, and 3-hydroxy 2-naphthoic acids was studied in a 1:1 mixture of dioxane and water using potentiometric and spectrophotometric methods. The stability constants of the mono-complexes were calculated from the potentiometric data. The values obtained were:

Acid	β_1
Salicylic	2.5×10^{13}
1-hydroxy 2-naphthoic	4.3×10^{13}
3-hydroxy 2-naphthoic	5.6×10^{12}

(auth)

39151 (AD-437101) BONDING REACTION AND MECHANISM IN CHEMICALLY BONDED ZIRCONIA. Interim Report. V. H. Edlin (Douglas Aircraft Co., Inc., Santa Monica, Calif.). Mar. 23, 1964. 40p. (SM-45945)

Progress is reported on work done to obtain an understanding of the bond mechanism involved in chemically bonded zirconia. Chemical bond phenomena were investigated by means of thermal gravimetric analysis, differential thermal techniques, x-ray diffraction, and stoichiometry studies. Zirconium pyrophosphate (ZrP_2O_7) and hydrated zirconium tetrafluoride ($ZrF_4 \cdot XH_2O$) were identified as reaction products for zirconia chemically bonded by monofluorophosphoric acid. (auth)

39152 (BNL-8038) A KINETIC STUDY OF THE DECOMPOSITION OF CESIUM–GRAPHITE LAMELLAR COMPOUNDS. F. J. Salzano and S. Aronson (Brookhaven National Lab., Upton, N. Y.). [1961]. Contract [AT(30-2)-Gen-16]. 14p. (CONF-571-6)

From American Chemical Society 148th National Meeting, Chicago, Aug.-Sept. 1964.

A kinetic study of the decomposition of the cesium–graphite compounds in vacuo has been carried out over the temperature range 400 to 650°C. A tracer technique was used in which the concentration of cesium in the compounds was measured by a scintillation scanning probe which continuously monitored the activity of tracer ^{134}Cs. The compounds studied were prepared by reacting well-annealed pyrolytic graphite with cesium vapor. It was observed that the decomposition of the cesium–graphite compounds proceeds in distinct stages. Within each stage, a constant rate of decomposition is observed. Each stage corresponds to the transition of one cesium–graphite compound to a compound containing less cesium. The kinetic data indicate the existence of a cesium–graphite phase ($C_{10}Cs$) which has not been previously reported. The existence of the $C_{10}Cs$ phase was subsequently confirmed by equilibrium vapor pressure measurements. The mechanism for the observed rates of decomposition assumes the rate limiting process to be the evaporation of cesium from the external surface of the solid. The proposed mechanism correlates the kinetic data with the thermodynamic properties of the compounds. (auth)

39153 (BNL-8039) THERMODYNAMIC PROPERTIES OF NONSTOICHIOMETRIC THORIUM MONOCARBIDE.

S. Aronson and J. Sadofsky (Brookhaven National Lab., Upton, N. Y.). [1964]. Contract [AT(30-2)-Gen-16]. 19p. (CONF-571-5)

From American Chemical Society 148th National Meeting, Chicago, Aug.-Sept. 1964.

Thermodynamic information on thorium carbides in the single phase region between $ThC_{0.96}$ and $ThC_{0.66}$ has been obtained from measurements on solid electrochemical cells. The cells were of the type $Th,ThF_4|CaF_2|ThF_4,ThC_x$ with $0.96 \geq x \geq 0.66$. Measurements were made at temperatures of 800 to 950°C. Partial molar free energies of thorium (relative to thorium metal) were calculated directly from the EMF data. The free energy at 900°C decreases from −0.4 kcal/mole at $ThC_{0.66}$ to −19.9 kcal/mole at $ThC_{0.96}$. The Gibbs-Duhem Equation was used to calculate the partial molar free energies of carbon (relative to solid carbon). The free energy at 900°C increases from −27 kcal/mole at $ThC_{0.66}$ to −4 kcal/mole at $ThC_{0.96}$. The thermodynamic data are discussed in connection with theories of chemical bonding which have been proposed for transition metal and actinide metal carbides. A reasonable qualitative picture of the bonding in nonstoichiometric thorium carbide is presented based on the assumption that thorium and carbon form covalent bonds which increase in strength as carbon is removed from the lattice. (auth)

39154 (EUR-1643.e(p.174-80)) INELASTIC NEUTRON SPECTRA OF ALKALI AND ALKALINE EARTH HYDROXIDES. K. Krebs and I. Pelah (European Atomic Energy Community. Joint Nuclear Research Center, Ispra, Italy).

The spectra of inelastically scattered cold neutrons from the lattices or LiOH, NaOH, KOH, $Mg(OH)_2$, $Ca(OH)_2$, $Sr(OH)_2$, and $Ba(OH)_2$ were studied. It is shown that a comparison of spectra obtained in neutron and optical spectroscopy may be used to clarify lattice interaction problems. (R.E.U.)

39155 (EUR-1643.e(p.181-7)) LOW HYDROGEN VIBRATION MODES IN HYDROGEN-BONDED FERROELECTRICS. K. Krebs and I. Pelah (European Atomic Energy Community. Joint Nuclear Research Center, Ispra, Italy).

Inelastic neutron scattering spectra of hydrogen-bonded ferroelectrics indicate the existence of low-frequency hydorgen modes of 200 to 700 cm^{-1}. The large splitting of the ground state in the double minimum potential of the hydrogen bond is supported in experimental neutron time-of-flight spectra for K_3PO_4, K_2HPO_4, KH_2PO_4, KD_2PO_4, Rb_3PO_4, Rb_2HPO_4, RbH_2PO_4, and KH_2AsO_4. (R.E.U.)

39156 (EUR-1643.e(p.327-45)) MOLTEN SALT CHEMISTRY IN FLUORIDE AND CHLORIDE MELTS. V. Lungagnani, S. Pizzini, and G. Sternheim (European Atomic Energy Community. Joint Nuclear Resarch Center, Ispra, Italy).

Molten salts are used in the nuclear field mainly as liquid fuels or as solvents for processing purposes; fluoride and chloride mixtures are chiefly used. From the electrochemical point of view these melts possess quite interesting features, which are summarized. A major part of the work carried out deals with the chemistry and electrochemistry of oxygen and water dissolved in fluoride and chloride melts. (auth)

39157 (HW-75072) A REVIEW OF THE REACTIONS OF NUCLEAR GRAPHITE WITH OXYGEN AND WATER VAPOR. R. E. Woodley (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Sept. 27, 1962. Contract AT(45-1)-1350. 14p.

The best presently available data on the thermal reactions of nuclear graphite with O_2 and water vapor are presented. (J.R.D.)

39158 (HW-77906) THE REACTIONS BETWEEN PuO_2 AND CARBON. R. E. Skavdahl (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). May 1964. Contract AT(45-1)-1350. 13p.

[Supersedes HW-SA-3117].

Evidence indicating a stable plutonium monooxycarbide phase and the formulation of the reaction sequence were the major results of an investigation of the reactions between PuO_2 and carbon. The formation of Pu_2C_3 occurred directly from beta-Pu_2O_3. The monooxycarbide, Pu(O,C), exhibited much higher volatility than beta-Pu_2O_3. Reaction temperatures of 1400 to 1500°C were sufficient for reduction to PuO, PuC, or Pu_2C_3; whereas, at least 1625°C was required for reduction to alpha- or beta-Pu_2O_3. (auth)

39159 (IS-822) CALCULATION OF ACID DISSOCIATION CONSTANTS. Wayne Woodson Dunning and Don S. Martin (Ames Lab., Ames, Iowa). Feb. 1964. Contract W-7405-eng-82. 74p.

A computational method has been developed for the determination of dissociation constants of acids (and bases). The method is applicable to mono or polybasic acids and, in certain cases, to mixtures of acids. A least-squares treatment is employed, and no simplifying assumptions are made in any of the equations or factors involved. All the available data are utilized, and provision is made for including or calculating activity coefficients. Utilization of the method requires a medium to large size digital computer. The resolution of successive dissociation constants of small ratio has been shown to present no difficulties attributable to such ratios; ratios as small as three were resolved as readily as those much larger. The accuracy attainable depends entirely upon the accuracy of the titration data. Tests have shown that titrations accurate to better than one part in five thousand may still produce two percent errors in the resulting constants. Consistent or random titration errors are likely to cause considerable variations in the dissociation constants. Experimental work must be performed with the greatest care if constants of even two significant figures are desired. Ordinary pH titrations may give uncertainties in even the first figure. Mixtures of acids proved to be no more difficult to resolve than single acids, within certain severe limits. If there is a considerable separation in constants, and the data are extremely accurate, useful results may be obtained. In most cases, overlap of constants and/or experimental errors will prevent successful resolution. Many previous methods of calculating dissociation constants have treated polybasic acids as mixtures of monabasic acids. It has been shown that if the ratio of successive constants is one hundred or more, no appreciable error results. With the present method, however, such assumptions are completely unnecessary. Examination of the literature, together with experimental results obtained in this work, indicates that many "accepted" values are either very inaccurate, or at least given to more significant figures than justified. (auth)

39160 (K-1617) AN IMPROVED THERMOBALANCE REACTOR FOR THE STUDY OF REDUCTION AND HYDROFLUORINATION OF URANIUM FEED MATERIALS. N. C. Orrick, C. F. Hale, C. G. Jones, Karl E. Rapp, and E. J. Barber (Oak Ridge Gaseous Diffusion Plant, Tenn.). Sept. 16, 1964. Contract W-7405-eng-26. 41p.

Two thermobalances have been constructed which make

use of an improved reactor design for the study of gas-solid reactions as they apply to the conversion of uranium oxide materials to uranium tetrafluoride. Since temperature has been recognized as one of the most important rate-governing factors for both of the reactions involved in this transformation, the reactor design provides for maintaining the sample temperature constant to ±1.0°C at any selected temperature over the range 100° to 600°C. Rate-controlling variables such as reaction temperatures, gas flow rates, preheating time and bed depth have been studied in order to establish the ranges over which small variations in these factors can be ignored. (auth)

39161 (K-L-1559) CAPITAL AND OPERATING COST ESTIMATES FOR CONVERSION OF URANIUM HEXAFLUORIDE TO URANO–URANIC OXIDE AT RATES OF 1, 10, AND 30 TONS OF URANIUM PER DAY. D. C. Brater and S. H. Smiley (Oak Ridge Gaseous Diffusion Plant, Tenn.). Apr. 22, 1963. Contract [W-7405-eng-26]. 30p.

Plant process requirements are given for conversion of depleted UF_6 to urano–uranic oxide at rates of 1, 10, and 30 tons U per day. The capital and operating costs for such facilities incorporating estimates of product composition, plant location, and sale or disposal of by-product HF are summarized. (J.R.D.)

39162 (LA-3046) THEORETICAL STUDIES OF ION EXCHANGE WITH SLOW PARTICLE DIFFUSION. R. S. Cooper and D. B. James (Los Alamos Scientific Lab., N. Mex.). Jan. 1964. Contract W-7405-eng-36. 74p.

Several aspects of ion exchange with slow particle diffusion are examined with a view toward understanding the behavior of plutonium in ion-exchange columns. A numerical solution has been developed which can include the effects of the nonlinear isotherm, the very low and variable solid diffusion coefficient, interaction between sorbed ions in the resin phase, and corrections for film and longitudinal diffusion in the solution. An analytic time-dependent solution for column operation with irreversible equilibrium is developed for several approximations to the diffusion process. This solution does not make the usual quasi-steady state assumption. Finally, diffusion into a sphere is examined in an attempt to match the experimental data for plutonium with Dowex 1 × 4 resin. These data could be fit by using a diffusion coefficient which depends exponentially upon the average concentration in the resin. However, a numerical solution of the diffusion in a sphere with a locally varying diffusion coefficient did not fit the data, nor did an analytic solution for combined diffusion and reaction. (auth)

39163 (LA-DC-6402) PREPARATION OF NEPTUNIUM-237 AND AMERICIUM-241 METAL ON THE MULTIGRAM SCALE. K. W. R. Johnson, J. A. Leary, and A. N. Morgan (Los Alamos Scientific Lab., N. Mex.). July 20, 1964. Contract W-7405-eng-36. 14p. (CONF-653-1)

From American Chemical Society Symposium, Chicago, Sept. 1964.

In the production of ^{239}Pu from ^{238}U, other radionuclides such as ^{237}Np and ^{241}Am are formed. Methods which were used to prepare ^{237}Np and ^{241}Am metal are summarized. For ^{237}Np, NpO_2 was converted to NpF_4 and then reduced by I_2 + Ca. Casting experience with ^{237}Np is described. For ^{241}Am, AmO_2 was reduced by La metal. (D.L.C.)

39164 (LA-DC-6595) STRETCH TDF—A CODE FOR COMPUTING THERMODYNAMIC FUNCTIONS. William R. Gage and Charles L. Mader (Los Alamos Scientific Lab., N. Mex.). Aug. 1964. Contract [W-7405-eng-36]. 80p. (GMX-2-R-64-2)

A description is given of a code for the IBM 7030 for computing the ideal gas thermodynamic function for monatomic, diatomic, and polyatomic gases and the thermodynamic functions for solids. The output of the calculations is designed to be the input to the STRETCH BKW code. (auth)

39165 (ONR-16(Vol.1)(p.175-88)) SOLID-STATE SPECTROSCOPY OF RARE EARTH IONS. R. A. Buchanan, J. Murphy, and H. H. Caspers (Naval Ordnance Lab., Corona, Calif.).

The 4f electronic energy levels in trivalent rare earths are discussed. The crystalline field effects, which can lead to stimulated coherent emission in certain types of host lattices, are considered. Charge compensation of trivalent rare earth ions in divalent host lattices is discussed briefly. Finally, studies of the spectra of Ce^{3+} in various crystals are described. (D.L.C.)

39166 (TID-21041) OXYANIONS AND PEROXIDES—THEIR CONSTITUTIONS AND REACTION MECHANISMS. Annual Report. John O. Edwards (Brown Univ., Providence). Aug. 20, 1964. Contract AT(30-1)-1983. 10p.

Progress is reported on the following studies: the aqueous chemistry of hydroxylamine-O-sulfonic acid, oxidation of nitrite ion and alcohols by peroxydisulfate ion, oxidation of phenylhydrazine by peroxyacetic acid, Lewis acid-base reactions of trimethyl borate, structure of some unusual peroxyborate compounds, nucleophilic displacements on oxygen, and isotope tracer studies. (N.W.R.)

39167 (TID-21064) THE RELATION OF VISCOSITY AND MOLECULAR WEIGHT FOR ISOTOPIC SPECIES OF HYDROCARBON GASES (thesis). Neal Harrold Prochnow (Vanderbilt Univ., Nashville. Graduate School). May 1964. 62p.

The measurement of viscosity of deuterated and research grade ethylene and methane is reported. The primary purpose of the work is to examine the validity of the relation given by Rowlinson. (J.R.D.)

39168 (UCRL-7521) VAPOR PRESSURE AND EVAPORATION COEFFICIENT STUDIES OF STANNIC OXIDE, ZINC OXIDE, AND BERYLLIUM NITRIDE (thesis). Clarence Leonard Hoenig (California. Univ., Berkeley and California. Univ., Livermore. Lawrence Radiation Lab.). Apr. 8, 1964. Contract W-7405-eng-48. 134p.

An analysis of kinetic gas theory and absolute rate theory with regard to decomposition vaporization reactions has been made. The enthalpy of sublimation of gold was measured to substantiate the accuracy of the balance-furnace system in subsequent Knudsen-Langmuir studies. The value obtained, 88.3 ± 0.4 kcal/mole, was comparable to the presently accepted value, 87.3 ± 0.3 kcal/mole. A Knudsen study of the reaction $SnO_{2(c)} = SnO_{(g)} + \frac{1}{2}O_{2(g)}$ yielded for the enthalpy of decomposition of $SnO_{(g)}$, D_0 = 5.44 ± 0.1 ev/molecule, which is in agreement with literature values (average 5.5 ± 0.1 ev/molecule) obtained by various methods. Langmuir studies indicated an evaporation coefficient upper limit of 0.1 for the measured reaction. The Langmuir enthalpy (ΔH°_{298} = 134 ± 2.9 kcal/mole) and entropy (ΔS°_{298} = 56 ± 2 cal/mole-°K) of activation as calculated by the second law method are less than measured for the equilibrium reaction (ΔH°_{298} = 143.4 ± 1.1 kcal/mole and ΔS°_{298} = 67 cal/mole-°K). Electron micrographs showed evidence of stepwise evaporation that depends upon the crystallographic orientation of the polycrystalline grains. Knudsen studies of the reaction $ZnO_{(c)} = Zn_{(g)} + \frac{1}{2}O_{2(g)}$ yield enthalpy of reaction which

is in agreement with values calculated from thermochemical data. Langmuir studies indicate an evaporation coefficient upper limit of 0.01–0.001 for this reaction. The Langmuir enthalpy of activation (ΔH^*_{298} = 140 ± 5 kcal/mole) was about 23% greater than the equilibrium enthalpy. The second law Langmuir entropy was about equal to the equilibrium entropy. Electron micrographs showed evidence of stepwise evaporation. Beryllium nitride evaporates congruently in the temperature region 1640 to 1950°K according to the reaction $Be_3N_{2(c)} = 3\ Be_{(g)} + N_{2(g)}$. The measured enthalpy of decomposition yields an enthalpy of formation for $Be_3N_{2(c)}$ of −136 ± 5.0 kcal/mole which is in good agreement with the literature (−137.8 ± 1.5 kcal/mole). Be_3N_2 has an evaporation coefficient upper limit of 0.001. The Langmuir enthalpy of activation (ΔH^*_{298} = 430.2 ± 6.8 kcal/mole) of a porous specimen was about 18% higher than the equilibrium enthalpy. The second law entropy for Langmuir evaporation (ΔS^*_{298} = 122.0 ± 4 cal/mole-°K) was slightly less than the calculated equilibrium entropy (ΔS^0_{298} = 131.4 ± 2 cal/mole-°K). In all three decomposition reactions studied, the entropy of Langmuir evaporation was about the same as the equilibrium entropy, indicating that the rate-controlling step was the final sublimation of gaseous products or at least a step that lies near the end of the evaporation process. (auth)

39169 (USNRDL-TR-754) ION EXCHANGE IN FUSED SALTS. I. A COMPARISON OF THE ION EXCHANGE CHARACTERISTICS OF FIVE MINERAL EXCHANGERS IN FUSED SODIUM NITRATE WITH REPRESENTATIVE ALKALI-METAL AND ALKALINE-EARTH CATIONS. C. M. Callahan and M. A. Kay (Naval Radiological Defense Lab., San Francisco). May 18, 1964. Contract AT(49-2)-1167. 33p.

The ion-exchange characteristics of the zeolitic minerals chabazite, heulandite, analcite, and natrolite, and of the felspathoid mineral sodalite, were surveyed in fused $NaNO_3$, using ^{22}Na, ^{86}Rb, ^{137}Cs, and ^{133}Ba as tracers. The survey was made to select a suitable solid ion exchanger that could be utilized effectively in a program concerned with ion exchange between fused salts and solid exchangers. The characteristics of interest that were investigated were the magnitude of the distribution coefficients, the reversibility of the exchange reaction, the time required to attain equilibrium in the exchange reaction, the thermal stability of the solid exchangers, and the compatibility of the solid exchanger with the fused media. Chabazite was found to possess the most desirable ion exchange characteristics. Analcite was found to be subject to irreversible mineral transformation when exchanged with other ions. Considerable hysteresis was present in heulandite and this effect was severe in the case of natrolite and sodalite. In all cases except analcite the severity of the hysteresis effect was found to be a function of the ionic radii of the exchanging ions and the porosity of the solid exchangers. The porosity of the exchangers could be correlated with the percentage of water contained in the natural minerals, especially with the "three-dimensional network" type of zeolite. (auth)

39170 (AEC-tr-6390(p.432-40)) INVESTIGATION OF THE MECHANISM OF OXIDATIVE REACTIONS BY THE ISOTOPE METHOD. A. I. Brodskiĭ, I. P. Gragerov, I. F. Franchuk, L. V. Sulima, I. I. Kukhtenko, V. A. Lunenok, A. S. Fomenko, and M. M. Aleksankin. Translated from Tr. Tashkentsk. Konf. po Mirnomu Ispol'z. At. Energii, Akad. Nauk Uz. SSR, 2: 327-?(1960).

Studies were made, using ^{18}O, of the oxidation of certain organic and inorganic substances, the mechanism of the formation and transformations of inorganic peroxide compounds, and the isotope exchange of oxygen in organic compounds of various classes. (M.C.G.)

39171 (AEC-tr-6390(p.451-9)) STUDY OF THE ADSORPTION OF THE ALKALINE EARTH AND RARE EARTH METALS ON CHERNOZEM BY THE LABELLED ATOM METHOD. É. A. Chuveleva, K. V. Chmutov, and P. P. Nazarov. Translated from Tr. Tashkentsk. Konf. po Mirnomu Ispol'z. At. Energii, Akad. Nauk Uz. SSR, 2: 341-?(1960).

An investigation was made of the exchange equilibria of certain rare earth and alkaline earth elements on chernozem and humic acid. The Na–Ce and Ca–Ce exchange equilibria were studied using ^{45}Ca and ^{144}Ce–^{144}Pr as the tracers. It was found that when microquantities of these elements are adsorbed by chernozem, they are adsorbed by the organic portion of the sorbent. It was also established that the selective absorption of polyvalent metallic ions by humic acid can be explained by the formation of complex compounds. Stability constants were determined for the complexes of cerium, yttrium, promethium, and calcium with humic acid. (M.C.G.)

39172 (AEC-tr-6390(p.460-5)) COPRECIPITATION OF SMALL AMOUNTS OF VARIOUS CATIONS AND ANIONS WITH METAL HYDROXIDES. A. I. Novikov. Translated from Tr. Tashkentsk. Konf. po Mirnomu Ispol'z. At. Energii, Akad. Nauk Uz. SSR, 2: 349-?(1960).

Data from tracer studies of the coprecipitation of Cs, Sr, Cd, Y, Ga, In, sulfates, chromates, tungstates, perrhenates, iodides, phosphates, and ions of other elements with ferric hydroxide, and in certain cases with other hydroxide as well, are presented. The isotopes ^{131}Cs, ^{89}Sr, ^{115}Cd, ^{90}Y, ^{114}In, ^{35}S, ^{51}Cr, ^{185}W, ^{189}Re, ^{131}I, and ^{32}P were used. The radioactivity was measured before and after precipitation of the hydroxide and its separation from the solution by centrifuging. Results are shown in graphs. (M.C.G.)

39173 (AEC-tr-6390(p.480-7)) USE OF RADIOACTIVE $C^{14}O_2$ TO INVESTIGATE THE VALUE OF THE SURFACE AREA IN SOLID STATE REACTIONS. B. V. Erofeev and V. A. Protashchik. Translated from Tr. Tashkentsk. Konf. po Mirnomu Ispol'z. At. Energii, Akad. Nauk Uz. SSR, 2: 363-?(1960).

The chemosorption of $^{14}CO_2$ was used to investigate the relative value of the surface of solid products obtained in the thermal decomposition of potassium permanganate in order to determine the nature of the autoacceleration observed. It was found that the original increase in the potassium permanganate surface leads to a decrease in the decomposition rate, and only as the surface is further increased is a comparatively weak increase in the rate observed. A proportionality between the reaction rate and the value of the surface of the solid product of the decomposition of potassium permanganate was demonstrated. (M.C.G.)

39174 (AEC-tr-6390(p.558-63)) A STUDY OF THE ELEMENTARY REACTIONS OF ATOMIC HYDROGEN WHICH OCCUR DURING THE RADIOLYSIS OF SOLID HYDROCARBONS UNDER MODEL CONDITIONS BY THE METHOD OF DEUTEROEXCHANGE. A. N. Ponomarev and V. L. Tal'roze. Translated from Tr. Tashkentsk. Konf. po Mirnomu Ispol'z. At. Energii, Akad. Nauk Uz. SSR, 2: 420-?(1960).

A study was made of the kinetics of deutero-hydrogen exchange between gaseous and solid phases during the hydrogenation of solid olefins with atomic hydrogen at a temperature of −196°C. Experiments were conducted with propylene, isobutylene, 2-methylbutene-1, or 3-methylbutene-1

frozen on the inner surface of a spherical reaction vessel. Then gaseous deuterium was passed into the vessel to a pressure of 4 to 5×10^{-2} mm Hg. Heating a tungsten filament in the vessel produced dissociation of the hydrogen. Exchange rates are shown on graphs. (M.C.G.)

39175 (AEC-tr-6390(p.586-93)) DEUTEROEXCHANGE ON SOLID SURFACES IN THE GASEOUS PHASE. S. V. Markevich and A. A. Ivko. Translated from Tr. Tashkentsk. Konf. po Mirnomu Ispol'z. At. Energii, Akad. Nauk Uz. SSR, 2: 440-?(1960).

Investigations were made of deuteroexchange in ethylene on an industrial aluminosilicate globular catalyst by mass spectral analysis. In the temperature range from 100 to 350°C onyl hydrogen exchange occurred. The reaction was bimolecular, proceeded according to a dissociative mechanism, and the deuterium content in the ethylene reached 22.8%. (M.C.G.)

39176 THE DETERMINATION OF THE STABILITY CONSTANTS OF THE LANTHANIDE α-HYDROXYISOBUTYRATE AND LACTATE COMPLEXES BY POTENTIOMETRIC TITRATION. H. Deelstra and F. Verbeek (Rijksuniversitiet, Ghent). Anal. Chim. Acta, 31: 251-7 (Sept. 1964).

The stability constants of the lanthanide and yttrium complexes with α-hydroxyisobutyrate and lactate, were determined by potentiometric titration. The average number of ligands bound per metal ion was calculated by the method of Calvin–Wilson. Results indicated the formation of uninegative tetra-ligand complexes of the form ML_4^-. The 4 formation constants were derived by 4 procedures: Bjerrum's half-$\bar{n}$-method, Fronaeus' and Poulsen's extrapolation methods, and by least squares calculation, using an IBM-1620 digital computer. (auth)

39177 STUDIES ON THE HYDROLYSIS OF METAL IONS. PART 50. THE HYDROLYSIS OF THE YTTRIUM(III) ION, Y^{3+}. George Biedermann and Liberato Ciavatta (Università, Naples). Arkiv Kemi, 22: 253-79(1964).

Hydrolysis equilibria of the Y^{3+} ion were studied at 25°C by measurement with a quinhydrone or a glass half-cell of the H ion concentration of a series of Y perchlorate solutions. The [Y(III)] of the test solutions, which were made to contain 3M ClO_4^- by adding $LiClO_4$, ranged from 0.025 to 1.0M. Solutions having an appreciable concentration of hydrolysis products were prepared by two methods: saturation of a slightly acidic Y perchlorate solution with hydrous Y oxide and generation of OH^- ions by constant current electrolysis in an initially unhydrolyzed solution and measuring with a coulometer the amount of electricity used. The data obtained in solutions prepared by the two methods agreed to within the uncertainty of the emf measurements. The emf data, which indicate that, at most, 3% of Y(III) can be transformed to hydrolyzed species without the formation of a precipitate, can be explained by assuming the three following equilibria: $Y^{3+} + H_2O \rightleftharpoons YOH^{2+} + H^+$ ($\log \beta_{1,1} = -9.1 \pm 0.1$); $2\ Y^{3+} + 2\ H_2O \rightleftharpoons Y_2(OH)_2^{4+} + 2\ H^+$ ($\log \beta_{2,2} = -14.30 \pm 0.05$); and $3\ Y^{3+} + 5\ H_2O \rightleftharpoons Y_3(OH)_5^{4+} + 5\ H^+$ ($\log \beta_{5,3} = -33.8 \pm 0.1$), where $\beta_{p,q}$ = formation constant of the species $Y_q(OH)_p^{(3q-p)+}$. It can be deduced on the basis of these equilibrium constants that the predominating hydrolysis products are the species $Y_2(OH)_2^{4+}$ and YOH^{2+}, whereas $Y_3(OH)_5^{4+}$ becomes important only when the point of precipitation is approached. Experimental problems arising when coulometry is employed to study ionic equilibria are discussed in detail and a volumetric method for the analysis of Y solutions is described. In developing this method it was found that to achieve a rapid precipitation the [Y(III)] must exceed 0.01M and a high value of $[\text{oxalic acid}]_{\text{total}}\,[Y(III)]^{-1}$ must be maintained. A series of analyses in which the acidity was varied indicated that the solubility minimum of Y oxalate lies around pH = 1 (prevailing in a 0.5M solution of oxalic acid) where the $[C_2O_4^{2-}]$ is high enough to prevent the presence of appreciable amounts of Y^{3+} in the solution while it is low enough to keep the concentration of oxalate complexes, such as YO_x^+, at an insignificant level. These conclusions were confirmed by solubility measurements using the tracer ^{90}Y. (BBB)

39178 TRANSFER OF IODINE FROM SOLUTIONS INTO SATURATED VAPOR. M. A. Styrikovich, O. I. Martynova, K. Ya. Katkovskaya, I. Ya. Dubrovskii, and I. N. Smirnova. At. Energ. (USSR), 17: 45-9(July 1964). (In Russian)

A survey is made of the quantitative distribution laws of elemental iodine and its hydrolysis products between boiling water and dry steam in equilibrium with it at pressures of 1.9, 4, and 10 kg/cm² in a pH range from 5.5 to 11. It is determined that the part of the hydrolysis products at small concentrations ($<10^{-5}$ to 10^{-4} moles/l) is practically equal to unity. The distribution function of HIO between boiling water and steam is expressed by an exponential function of the ratio of the densities of the vapor and liquid phase. The obtained data should be considered for the radial organization of the water circuit of evaporators and for the selection of probes for boiling reactors, in which ^{131}I is used as a detector of fuel-element cladding failure. (tr-auth)

39179 FURTHER INVERSE GAMMA-DEUTERIUM ISOTOPE EFFECTS IN SOLVOLYTIC REACTIONS. M. J. Blandamer and R. E. Robertson (National Research Council, Ottawa). Can. J. Chem., 42: 2137-8(Sept. 1964). (NRC-8059)

From previous studies it was concluded that enhanced steric hindrance would lead to a corresponding increase in the inverse γ-deuterium isotope effect. This expectation was not supported by experiment. The inverse γ-deuterium isotope effect for the hydrolysis of n-propyl halides was reduced for the isobutyl cases and was "normal" for neopentyl methanesulfonate. (M.C.G.)

39180 CONTEMPORARY STATE OF THE CHEMISTRY OF MENDELEVIUM. Jaromir Maly and Jiri Brandsteter (Inst. for Nuclear Research, Rez, Czechoslovakia and Univ. of Brno). Chem. Listy, 58: 751-62(July 1964). (In Czech)

The preparation, separation methods, and study of chemical properties of mendelevium are described. The importance of proving the theoretical principles of Mendeleev's periodical table even for the heaviest elements is stressed. Predicting properties of as yet unknown isotopes is discussed. Present-day methods for the preparation of transuranium elements yield only neutron-deficient isotopes of relatively short half lives. The use of chromatographic methods is discussed. (TCO)

39181 ISOTOPIC EXCHANGE OF IODINE BETWEEN SOME ALKYL IODIDES AND ELEMENTAL IODINE DISSOLVED THEREIN. K. Svoboda (Inst. of Nuclear Research, Czechoslovak Academy of Sciences, Řež). Collection Czech. Chem. Commun., 29: 1531-7(July 1964).

Isotopic exchange of iodine between elemental iodine and alkyl iodides (methyl iodide, ethyl iodide, n-propyl iodide, n-butyliodide) in homogeneous liquid phase at 20 and 50°C was studied. Half-time for the exchange reactions in individual systems, and, on the assumption of bimolecular and pseudomolecular mechanisms, rate constants of exchange were determined. Activation energies of the exchange reactions studied were established. (auth)

39182 EFFECTS OF SOLVENTS ON THE SIZE OF INFRARED ABSORPTION BANDS AND ON CHEMICAL SHIFT IN NUCLEAR MAGNETIC RESONANCE. Pierre Jouve, Michele Teulier, and Georges Levi (Laboratoire de Spectroscopie Hertzienne, Paris). Compt. Rend., 259: 119-22(July 6, 1964). (In French)

Preceding works on the acetylenic compounds established, in a study of the intramolecular effects, a relation between the intensity of the infrared absorption bands and the chemical displacement (δ) in NMR. An analogous relation is established for the intermolecular effects. The parameter $L\Delta\nu$ (band width) $\times$ ($\nu_{gas} - \nu_{solution}$) is stated as a function of δ. (tr-auth)

39183 HIGH-TEMPERATURE SYNTHESIS AND CERTAIN PROPERTIES OF NEUTRAL TUNGSTATES OF YTTRIUM, LANTHANUM AND LANTHANOIDS. V. E. Plyushchev and V. M. Amosov (Lomonosov Inst. of Fine Chemical Tech., Moscow). Dokl. Akad. Nauk SSSR, 157: 131-4(July 1, 1964). (In Russian)

The rare earth oxide Me_2O_3 was mixed with WO_3 in a molecular ratio varying from 4:1 to 1:4. The powder mixture (2-3 μ grain size) was sintered for 4 hours at 800 to 1000°C. The sintered powder was ground, and the sintering was repeated three times. The product was subjected to x-ray analysis, microscopic analysis, and selective dissolution in a mixture of HCl and H_3PO_4 in order to remove unreacted Me_2O_3 and the rare earth tungstate. Free WO_3 calcined at high temperature was insoluble in the acid mixture. X-ray and chemical analysis showed that a neutral rare earth tungstate with the composition $Me_2O_3 \cdot 3WO_3$ is formed. The reaction goes to completion in a short time at 900°C. The density varies from 6.506 for the La compound to 7.948 for the Ho compound. The melting points vary from 1140°C for the La compound to 1460°C for the Ho compound. The color of the rare earth tungstates varies from white to light yellow. (TTT)

39184 THE STATE OF PROTACTINIUM IN NITRATE SOLUTIONS. Vict. I. Spitsyn, R. A. Dyachkova, and V. P. Khlebnikov (Inst. of Physical Chemistry, Academy of Sciences, USSR). Dokl. Akad. Nauk SSSR, 157: 135-8 (July 1, 1964). (In Russian)

The state of Pa in HNO_3 solution was estimated by solvent extraction of the Pa by tributylphosphate (TBP) in benzene. The isotopes ^{231}Pa and ^{233}Pa were used as tracers. It was found that equilibrium was established in <1 hr with freshly prepared solutions of Pa, but in aged solutions held for 4 months, equilibrium was not attained even after 100 hours. A gradual increase in the distribution coefficient was due to the slow establishment of equilibrium between the extractable and nonextractable forms of Pa, and not to the breakdown of TBP. The slow attainment of equilibrium indicates that the nonextractable form of Pa is polymeric or colloidal in character. It was calculated that the amount of nonextractable Pa is ~43% in 7.6N HNO_3 (10^{-10}M Pa solution aged 4 months), while it is ~3% in a freshly prepared solution. The distribution coefficient was determined as a function of TBP concentration, hydrogen ion, and nitrate ion concentration at a constant ionic strength of 5 in the equilibrium aqueous phase. The most probable mechanism of extraction is represented by the equation: $Pa(OH)_2^{3+} + 2H^+ + 5NO_3^- + 2TBP \rightleftharpoons Pa(NO_3)_5 \cdot 2TBP + 2H_2O$. The stability constants for the nitrate complexes of Pa were calculated to be 17 for $[Pa(OH)_2(NO_3)]^{2+}$, 127 for $[Pa(OH)_2(NO_3)_2]^{+}$, 540 for $[Pa(OH)_2(NO_3)_3]^{0}$, and 1380 for $[Pa(OH)_2(NO_3)_4]^{-}$. The dominant form of Pa at $[NO_3^-]$ >1M is the anion $[Pa(OH)_2(NO_3)_4]^{-}$. (TTT)

39185 THERMODYNAMICS. J. M. Smith, B. Caswell, and P. V. Shaw. Ind. Eng. Chem., 56: No. 9, 41-52(Sept. 1964).

A review on thermodynamics is presented. 454 references are cited according to information on: equations of state; P-V-T and critical data; vapor pressure and heats of vaporization; heat capacity; general thermodynamic properties; ideal gas thermodynamic properties; heat of mixing; vapor-liquid equilibria; liquid-liquid and solid-solid equilibria; and chemical equilibria. (P.C.H.)

39186 THE PREPARATION, PROPERTIES, AND CRYSTAL STRUCTURES OF SOME SCANDIUM SULFIDES IN THE RANGE Sc_2S_3–ScS. J. P. Dismukes and J. G. White (Radio Corp. of America, Princeton, N. J.). Inorg. Chem., 3: 1220-8(Sept. 1964).

Scandium sesquisulfide, Sc_2S_3, was prepared by the high-temperature reaction of hydrogen sulfide with scandium sesquioxide. Due to the problem of stoichiometry associated with the high melting point, 1775°C, stoichiometric crystals of Sc_2S_3 were prepared by chemical transport with I_2 at 950°C. A nonstoichiometric material containing an excess of scandium compared with Sc_2S_3 was prepared by heating Sc_2S_3 under vacuum at 1650°C. Crystals of ScS were prepared by the reaction of scandium metal with sulfur. The crystal structure of Sc_2S_3 is closely related to that of NaCl, but the unit cell is twelve times as large due to a complex ordering arrangement of the cation voids. Each octahedron surrounding sulfur has two vertices empty, and the bond angles are all very close to 90°C. The nonstoichiometric material has a much simpler structure which is also closely related to that of NaCl, with $Sc_{1.37}S_2$ per rhombohedral unit cell. This structure, in which one cation site is filled and the other is only partially occupied, could exist over the whole range between Sc_2S_3 and ScS, which was found to have the NaCl structure. Stoichiometric Sc_2S_3 is a semiconductor with a band gap of about 2 ev but the materials between Sc_2S_3 and ScS are good electrical conductors. Electrical conduction in the latter materials appears to involve a 3d band. (auth)

39187 POTASSIUM DOUBLE CARBONATES OF PENTAVALENT NEPTUNIUM, PLUTONIUM, AND AMERICIUM. T. K. Keenan and F. H. Kruse (Los Alamos Scientific Lab., N. Mex.). Inorg. Chem., 3: 1231-6(Sept. 1964). (LADC-6368)

The crystalline compounds $KNpO_2CO_3$ and $KAmO_2CO_3$ were prepared by addition of potassium bicarbonate to an aqueous solution of the pentavalent MO_2^+ ion. They are isostructural with $KPuO_2CO_3$; hexagonal, space group $C6/mmc\text{-}D_{6h}^4$, Z = 2, with lattice constants: $KNpO_2CO_3$, a_0 = 5.120 ± 0.001 Å, c_0 = 9.971 ± 0.003 Å; $KPuO_2CO_3$, a_0 = 5.093 ± 0.001 Å; c_0 = 9.815 ± 0.002 Å; $KAmO_2CO_3$, a_0 = 5.112 ± 0.001 Å; c_0 = 9.740 ± 0.002 Å. (auth)

39188 STRUCTURAL STUDIES OF ZIRCONIUM TRIHALIDES AND HAFNIUM TRIIODIDE. Lawrence F. Dahl, Tao-I Chiang, Pyrtle W. Seabaugh, and Edwin M. Larsen (Univ. of Wisconsin, Madison). Inorg. Chem., 3: 1236-42 (Sept. 1964).

Structural studies of $ZrCl_3$, $ZrBr_3$, ZrI_3, and HfI_3 were made from x-ray powder diffraction patterns. The isomorphous compounds contain two formula units in a hexagonal unit cell and have the following dimensions in Å (all with esd ± 0.01 Å) and densities in g/cc at 25°C: $ZrCl_3$, a = 6.36, c = 6.14, d_{exptl} = 2.95, d_{calcd} = 3.05; $ZrBr_3$, a = 6.75, c = 6.315, d_{exptl} = 4.52, d_{calcd} = 4.42; ZrI_3, a = 7.25, c = 6.64, d_{exptl} = 5.13, d_{calcd} = 5.20; HfI_3, a = 7.225, c = 6.59, d_{exptl} = 6.17, d_{calcd} = 6.25. Systematic absences of

l odd for h0l reflections indicate as probable space groups, D_{6h}^3-$P6_3/mcm$, C_{6v}^3-$P6_3cm$, and D_{3h}^2-$P\bar{6}c2$. From space group assignment (D_{6h}^3-$P6_3/mcm$), intensity calculations, and stereo-chemical considerations (with the assumption of no order-disorder phenomenon) a structure based on a distorted hexagonal close-packing of the halogen atoms can be proposed which consists of infinite chains along the c axis formed by MX_6 octahedra joined at opposite faces with the metal atoms regularly spaced midway between the halogen atoms; the resulting metal-metal distance is equal to one-half the c lattice constant. Evidence is presented to show that previous powder work including another space group assignment (D_{3h}^3-$P\bar{6}2m$) and a formulated structure of linear chains of $(Zr_2X_6)n$ units is not substantiated by the powder data. A qualitative MO theory of bonding is proposed from which direct metal-metal interactions can be postulated for a chain configuration. (auth)

39189 THE ROLE OF THE MONOFLUOROIRON(III) ION IN THE IRON(II)–IRON(III)–FLUORIDE ION ISOTOPE EXCHANGE REACTION. Jameel Menashi Shouzow Fukushima, Charles Foxx, and Warren L. Reynolds (Univ. of Minnesota, Minneapolis). Inorg. Chem., 3: 1242-5 (Sept. 1964).

The iron(II) + iron(III) exchange rate was measured in $NaF-NaClO_4-HClO_4$ media at constant pH and ionic strength. The iron(II) concentration was increased so as to make the isotope exchange rate comparable to the rate of formation of the inner coordination shell complex FeF^{2+}. The observed isotope exchange rate was dependent on the rate of formation of FeF^{2+} in the manner expected if the activated complex $[Fe_2F^{+4}]^*$ was formed from $Fe^{+2}(aq)$ and $FeF^{+2}(aq)$. (auth)

39190 COMPLEXING OF METAL IONS WITH SEMIQUINONES. AN ELECTRON SPIN RESONANCE STUDY. D. R. Eaton (E. I. du Pont de Nemours & Co., Wilmington, Del.). Inorg. Chem. 3: 1268-71(Sept. 1964).

Complexing of the o-semiquinone radical with diamagnetic ions of the group II and III metals Mg, Ca, Sr, Ba, Zn, Cd, Al, Y, and La was studied by e.s.r. Changes in the proton hyperfine coupling constants and the appearance of additional splitting due to interaction with the nuclear moment of the metal were observed. Correlations between the e.s.r. results and the heats of hydration of the metal ions were found. Calculations based on a simple model in which the effects of the complexing are expressed in terms of variation of the Coulomb integral of the semiquinone oxygen atoms give results in qualitative agreement with experiment. The effects of complex formation on the oxidation-reduction potentials of the semiquinones are discussed. (auth)

39191 COMPLEXES OF THE RARE EARTHS. VIII. PICOLINIC ACID. Larry C. Thompson (Univ. of Minnesota, Duluth). Inorg. Chem., 3: 1319-21(Sept. 1964).

The solution stabilities of the complexes between picolinic acid and the rare earths were measured at 25°C and ionic strength 0.1 M (KNO_3). The complexes are somewhat stronger than were expected. Evidence is presented from which it is concluded that the heterocyclic nitrogen atom is coordinated as well as the carboxyl group. (auth)

39192 A LITHIUM EUROPIUM HYDRIDE INVERSE PEROVSKITE PHASE, $LiEuH_3$. Charles E. Messer and Kenneth Hardcastle (Tufts Univ., Medford, Mass.). Inorg. Chem., 3: 1327-8(Sept. 1964).

The preparation and characterization by x-ray powder diffraction of the inverse perovskite phases of $LiEuH_3$ and $LiYbH_3$ are described. Lattice constants and density values are given. (N.W.R.)

39193 ANOTHER PREPARATION METHOD OF VANADIUM(III) AND URANIUM(IV) 1,3-DIKETONE COMPLEXES. D. Grdenić and B. Korpar-Colig (Univ. of Zagreb). Inorg. Chem., 3: 1328-9(Sept. 1964).

Vanadyl(IV) and uranyl(VI) acetylacetonates as well as 1,3-diphenyl-1,3-propanedionates are reduced by zinc powder in a medium containing an excess of the appropriate diketone to the corresponding vanadium(III) and uranium(IV) complexes. The reduction is a convenient laboratory preparation of vanadium(III) and uranium(IV) acetylacetonates in practically quantitative yield from common chemicals. The solutions of the reduced metal 1,3-diketonates are fairly stable; no sign of oxidation during the course of preparation is noticed. (N.W.R.)

39194 DETERMINATION OF THERMAL CONDUCTIVITIES OF SESQUISULFIDES OF SOME RARE-EARTH METALS. V. I. Marchenko and I. G. Barantseva (Inst. of Metal Ceramics and Special Alloys, Kiev). Inzh. Fiz. Zh., Akad. Nauk Belorussk. SSR, 7: 120-2(June 1964). (In Russian)

Thermal and electric conductivities of La_2S_3, Ce_2S_3, Pr_2S_3, and Nd_2S_3 are determined. It is found that at room temperature heat transfer in these compounds takes place owing to oscillations of the lattice. In the series $La_2S_3 \rightarrow Nd_2S_3$ the rise in heat conductivity is observed. Estimation of the electronic and phonon components is given. (auth)

39195 THE FINE STRUCTURE OF L_{III} ABSORPTION SPECTRA OF CERTAIN RARE EARTHS IN OXIDES AND HEXABORIDES. N. V. Troneva. Izv. Akad. Nauk SSSR, Ser. Fiz., 27: 809-10(May 1964). (In Russian)

The L_{III} absorption spectra of Gd in Gd_2O_3 and GdB_6, of Pr in PrB_6 and of Sm in Sm_2O_3 in the vicinity of 200 ev were obtained on a photographic, long-wavelength spectrograph equipped with a quartz crystal. The bending radius of the crystal was 350 mm which reflected the $|10\bar{1}0|$ plane and the oblique $|13\bar{4}0|$ plane. The wavelength of the L_{III} white line in Gd_2O_3 is 1706.74 X units (7247.97 ev), and it is 1707.04 X units (7246.69 ev) in GdB_6. The fine structure in Gd_2O_3 differs from that in GdB_6. The L_{III} white line of GdB_6 is shifted to the side of lower energies by 1.3 ev. The half-width of the L_{III} white line in GdB_6 is somewhat smaller. A correlation is observed between the half-width of the white line and the degree of participation of 4f- and 5d-electrons in the chemical bonding. Thus, the half-width of the L_{III} ($2p \rightarrow 5d$) line is less in the hexaborides of Ce, Gd, and Yb as compared to the half-width in the corresponding oxides. The results are an additional confirmation of the predominance of the metallic bond in the hexaborides. (TTT)

39196 SCANDIUM EMISSION SPECTRA IN Sc_2O_3. M. A. Blokhin and V. F. Demekhin (Rostov-on-Don State Univ., USSR). Izv. Akad. Nauk SSSR, Ser. Fiz., 27: 830-1 (May 1964). (In Russian)

Carrying out a comparison study of spectra of excited and ionized atoms, the K absorption spectrum of Sc in Sc_2O_3 and the doublet $TiK_{\alpha_{1,2}}$ were examined. It was found that the $TiK_{\alpha_{1,2}}$ photons are distributed in the long-wavelength region of the K absorption of Sc. This absorption region is controlled by the transition of the K electrons at the level of the excitons; therefore, when Sc is excited by the $TiK_{\alpha_{1,2}}$ photons, only excited Sc atoms are obtained because the actual absorption edge is located in the shorter wavelength

region of the spectrum. While studying the emission spectrum of Sc in Sc_2O_3 by means of a quartz crystal having a resolution of about 16,000, the location of the $ScK_{\alpha_{1,2}}$ lines was determined with respect to the CaK_{β_1} line, and that of the $ScK_{\beta_{1,2}}$ —with respect to the $TiK_{\alpha_{1,2}}$ line. The results indicate that the thus obtained lines of the K series of the spectrum are emitted only by the excited and not by the ionized atoms of Sc. The excitation method does not affect the other lines of the Sc spectrum. There is a complete similarity between the K_{β_5}-threshold and the remaining lines of the K series in the secondary and tertiary spectra of Sc. (TTT)

39197 ON THE M-EMISSION BAND OF Zr, Nb, AND Mo AND THEIR COMPOUNDS. T. M. Zimkina, O. A. Ershov, and A. I. Lukirskii. Izv. Akad. Nauk SSSR, Ser. Fiz., 27: 836-40(May 1964). (In Russian)

The effect of C, N, and O, impurities in the anode on the M-emission bands of Zr, Nb, and Mo was investigated by means of a new gold-covered grid in the spectrometer. The anode temperature was heated to >1000°C in order to eliminate the effect of C, N, and O impurities. It was found that the double-humped structure of Zr changes to a smooth continuous curve, but that noticeable inflections remain in the M-emission bands of Nb and Mo. The results showed that carbon has a significant effect on the M-emission band of Nb, because the anode surface is rapidly covered with carbon even at a vacuum of 2×10^{-6} mm Hg std. Oxygen and nitrogen contaminants do not form in vacuum. The M-emission band of Mo_2C is the same as that of a Mo surface contaminated with carbon. A nitrogen impurity can also distort the emission band of Nb due to the formation of NbN. An additional maximum appears at a distance of 4.6 ev from the main maximum. The widths of the M-level, and the band widths at half height are given for Zr, Nb, and Mo. The relative intensities of lines in Zr, Nb, and Mo are given in relative intensities, and in number of quanta. (TTT)

39198 EFFECT OF A METHOD OF ADDING K_2CO_3 ON THE KINETICS OF CARBON REDUCTION OF HIGHER URANIUM OXIDES. E. V. Tkachenko, V. G. Vlasov, and Yu. N. Semavin (Urals Polytechnic Inst., USSR). Izv. Vysshikh Uchebn. Zavedenii, Tsvetn. Met., No. 2, 135-9 (Mar.-Apr. 1964).

The results of a study on the effects of K_2CO_3 on the kinetics of reduction of U_3O_8 and UO_3 are reported. Experiments were carried out at 700 and 460°C, respectively. U_3O_8 was prepared by calcining uranium peroxide in air at 800°C for three hours. It had a specific surface of ≈2.5 m^2/g, and specific gravity of ≈8 g/cm^3. UO_3 was obtained by calcining uranium peroxide at 400°C for four hours. The powder had a specific surface of ≈13 m^2/g, and a specific gravity of 6 g/cm^3. X-ray diffraction established that the UO_3 was amorphous, while the U_3O_8 had an orthorhombic structure. The reductant used was an amorphous acetylene carbon black with an ash content of 0.07%, which had been heated in a vacuum desiccator for ten hours at 250°C. The content of reductant in the reaction mixture was always 20% of the weight of the oxide. Potassium carbonate was added in the amount of 5 wt % of the weight of the oxide to be reduced. K_2CO_3 was introduced into the oxide, the carbon, or their mixture in various forms: as a dry salt, as a solution, and by impregnation. It was found that as the K_2CO_3 decomposes, it activates the reagents, causing an acceleration of the reduction rate. On the other hand, its reaction with the uranium oxides leads to the formation of reduced uranate oxides on the surface, which shield a portion of the latter and lower the reduction rate. Therefore, the overall effect of adding K_2CO_3 on the carbon reduction of uranium oxides is determined by the relative importance of these two factors, which oppose each other. When UO_3 is reduced (at 460°), K_2CO_3 tends to decelerate the reduction process owing to the shielding action of the potassium uranate formed. When U_3O_8 is reduced, formation of uranates is accompanied by decomposition of K_2CO_3. It was found that whatever the variants used for introduction of the additive, the reduction of U_3O_8 was always accelerated. The smaller the amount of potassium uranates formed, the greater is this acceleration. Therefore, the greatest increase occurs when the additive is introduced into the reducing agent in the dry form. (OTS)

39199 POTASSIUM PERXENATE NONAHYDRATE. Allan Zalkin, J. D. Forrester, David H. Templeton, Stanley M. Williamson, and Charles W. Koch (Univ. of California, Berkeley). J. Am. Chem. Soc., 86: 3569-71(Sept. 5, 1964). (UCRL-11514)

The preparation and properties of potassium perxenate nonahydrate are given. The crystal structure is shown and described by x-ray diffraction analysis. (N.W.R.)

39200 THE KINETICS OF THE EXCHANGE OF SULFUR-35 BETWEEN THIOSULFATE AND SULFIDE. Ennio Ciuffarin and William A. Pryor (Louisiana State Univ., Baton Rouge and Purdue Univ., West Lafayette, Ind.). J. Am. Chem. Soc., 86: 3621-6(Sept. 20, 1964).

The rate of exchange of sulfur between sodium sulfide-S-35 and sodium thiosulfate was measured at temperatures between 100 and 140°C. The order in sulfide is less than 1, and that in thiosulfate is greater than 1; however, in the presence of added sulfite, the order in both sulfide and thiosulfate becomes 1.0. Using data obtained in the presence of added sulfite, and also data obtained by adding disulfide, the mechanism of the exchange was concluded to be a displacement on the outer sulfur of thiosulfate by sulfide ion. However, the mechanism is complicated by a simultaneous exchange of S-35 between disulfide and thiosulfate. Trisulfide and higher polysulfides probably also react in this way, but these reactions are not important in the present system. In addition to these reactions, an exchange occurs between sulfide and disulfide. The rate law for the exchange includes a term in sulfide and one in disulfide. It is shown that this rate law plus the equilibrium reaction explains both the nonintegral kinetic orders in the absence of sulfite and the integral orders produced by the addition of sulfite. The activation energy for k_1 is 17.8 kcal/mole, and the apparent activation energy for the sum of the sulfide and disulfide terms is 17.4 kcal/mole. The following values for the rate constants are obtained at 100°C, pH 12.46, μ = 2.3, and (Na^+) 1.5 M: $k_1 = 9.8 \times 10^{-5}$, $k_2 = 9.5 \times 10^{-3}$, $k_{-1} = 0.13$ (all in 1 $mole^{-1}$ sec^{-1}). (auth)

39201 ISOTOPE EFFECTS IN MERCURIDEBORONATIONS MEASURED BY NEUTRON ABSORPTION. D. S. Matteson, James O. Waldbillig, and S. W. Peterson (Washington State Univ., Pullman). J. Am. Chem. Soc., 86: 3781-3(Sept. 20, 1964).

Boron isotope effects in mercurideboronations were determined by measurement of the neutron absorption cross sections of appropriately derived boric acid samples. The k_{10_B}/k_{11_B} ratio for the reaction of mercuric chloride with exo-5-norbornene-2-boronic acid in 83% acetone at 25°C to form nortricyclylmercuric chloride was 1.033, that for the endo isomer in refluxing 75% acetone 1.027, both ± 0.005, and that for the reaction of phenylmercuric nitrate with benzeneboronic acid in refluxing 40% ethanol was 1.021 ± 0.009. (auth)

39202 MECHANISMS OF ELIMINATION REACTIONS. V. SULFUR ISOTOPE EFFECTS IN SOME REACTIONS OF t-BUTYLDIMETHYLSULFONIUM IODIDE. William H. Saunders, Jr., and Stuart E. Zimmerman (Univ. of Rochester, N. Y.). J. Am. Chem. Soc., 86: 3789-91(Sept. 20, 1964).

The E2 reaction of t-butyldimethylsulfonium ion with ethoxide ion in 97% ethanol at 24°C showed a $^{32}S/^{34}S$ isotope effect of 0.72%. The Sn1–E1 solvolysis of the same compound in 97% ethanol at 40°C showed a $^{32}S/^{34}S$ isotope effect of 1.03%. These results were compared with earlier work, and their mechanistic significance is discussed. (auth)

39203 THE TRANSITION STATE IN METHYL RADICAL FORMATION. THE SECONDARY α-DEUTERIUM ISOTOPE EFFECT. Andreas A. Zavitsas and Stanley Seltzer (Brookhaven National Lab., Upton, N. Y.). J. Am. Chem. Soc., 86: 3836-40(Sept. 20, 1964). (BNL-7947)

The secondary α-deuterium isotope effect was determined for the unimolecular formation of methyl and methyl-d_3 radicals and acetophenone from methyltrideuteriomethylphenylcarbinyl hypochlorite. k_H/k_D varied from 1.17 at –9° to 1.12 at 75°C. From the temperature dependence of the effect it was concluded that the transition state is more akin to products than to the reactant oxy radical. (auth)

39204 THE HYDROGEN CARRIER TECHNIQUE FOR THE PYROLYSIS OF TOLUENE. J. G. Burr, R. A. Meyer, and J. D. Strong (North American Aviation Science Center, Canoga Park, Calif.). J. Am. Chem. Soc., 86: 3846-50 (Sept. 20, 1964).

The only products formed from the pyrolysis of toluene at 750°C with a hydrogen or deuterium carrier gas are methane and benzene. The apparent activation energy for toluene consumption is 46.1 kcal/mole (log A = 7.87). It was concluded that the effect of the carrier gas is to replace the ordinary nonchain toluene pyrolysis mechanism by a chain reaction with hydrogen atoms as the chain carrier. The isotopic compositions of the products formed when toluene-d_8, ring-deuterated toluene, and methyl-deuterated toluene are pyrolyzed with deuterium or hydrogen as the carrier gas suggest that the difference between C—H and C—D bonds is as important as the difference between ring and side-chain C—H bonds in determining the site of methyl and phenyl radical reactions. Both methyl and phenyl radicals abstract hydrogen preferentially from the toluene ring rather than from the side chain. (auth)

39205 ACTIVATION ENERGY OF DEUTERIUM–HYDROGEN EXCHANGE IN AMIDES. Irving M. Klotz and Bruce H. Frank (Northwestern Univ., Evanston, Ill.). J. Am. Chem. Soc., 86: 3889(Sept. 20, 1964).

The effects of temperature on the kinetics of deuterium exchange in a model amide, N-methylacetamide, $CH_3CONHCH_3$, were studied when it is entirely in the monomeric state. Exchange rates were followed for solutions of 1 M N-methylacetamide in D_2O by observation of changes in absorbance at 1.43 μ in the near-infrared region of the spectrum. It was found immediately at room temperature that the rate of exchange was acid- and base-catalyzed. In the range pD 4.5–5.5, the exchange was acid-catalyzed at each of three temperatures, 12, 24, and 32°C. The activation energy, calculated from the temperature coefficient of the rate constant at pD 5.0, is 17 kcal/mole. The rate reaches a minimum at approximately pD 5.5. Above pD 5.5 it is base-catalyzed, and rate constants were measured over the range pD 5.5–6.5. Data at pD 6.3 were used to calculate the activation energy, and a value of 23 kcal/mole was obtained. (P.C.H.)

39206 A KRYPTON DIFLUORIDE–ANTIMONY PENTAFLUORIDE COMPLEX. Henry Selig and Raymond D. Peacock (Argonne National Lab., Ill.). J. Am. Chem. Soc., 86: 3895(Sept. 20, 1964).

Preparation of the complex $KrF_2 \cdot 2SbF_5$ is reported. The compound is formed by treating KrF_2 with SbF_5 in glass or Kel-F. Reaction is complete at –20°C, and if excess SbF_5 is present, most of the white crystalline material formed dissolves to give a clear yellowish solution at room temperature. The complex is more stable and much less volatile than the parent difluoride. It melts at about 50°C, but the liquid decomposes quickly to SbF_5, Kr, and F. The infrared spectrum of the complex shows a strong characteristic absorption band at 813 cm^{-1} and other strong, poorly resolved absorptions in the 600–700 cm^{-1} region. (P.C.H.)

39207 CRYSTALLOGRAPHIC STUDIES OF KRYPTON DIFLUORIDE. Stanley Siegel and Elizabeth Gebert (Argonne National Lab., Ill.). J. Am. Chem. Soc., 86: 3896 (Sept. 20, 1964).

Samples of KrF_2 were found to be sufficiently stable to enable crystallographic information to be obtained. Single crystal oscillation and Weissenberg patterns indicate that the symmetry is tetragonal, with a = 6.533 and c = 5.831 Å. The calculated x-ray density, assuming four molecules in the cell, is 3.24 g/cm^3. The cell appears to be primitive and therefore is not isostructural with XeF_2. (P.C.H.)

39208 BONDING IN XENON HEXAFLUORIDE. Joyce J. Kaufman (RIAS Div., Martin Co., Baltimore). J. Chem. Educ., 41: 183-4(Apr. 1964).

The theory of bonding in the lower members of compounds of Xe and F, XeF_2 and XeF_4, is discussed. The distinguishing difference is that one group favors Xe 5d orbital hybridization with its 5s and 5p orbitals; the other favors bonds involving primarily only the Xe 5p orbitals. Both hybridization or nonhybridization of Xe and 5s and 5d orbitals with Xe 5p orbitals appear to predict correctly a linear structure for XeF_2 and a square planar structure for XeF_4. The inclusion of Xe 5d orbital hybridization would seem to indicate for XeF_6 two possible structures, a pentagonal pyramid or an irregular octahedron (both based on fragments of a pentagonal bipyramid in which one vertex is unoccupied). These structures would arise from consideration of the most stable arrangement of seven electron pairs (whether bonded or nonbonded) around a central atom in sp^3d^3 ($sp^3d_y{}^2d_z$) hybridization. However, there is a structural possibility for XeF_6, alternative to these two forms, involving only partial Xe 5d orbital hybridization which could lead to an octahedral XeF_6 structure in the following manner. The Xe atom is in sp^3d^2 ($sp^3d_z{}^2d_{x^2-y^2}$) hybridization which would place the F atoms symmetrically around the Xe at the vertices of an octahedron, while the extra lone-pair of electrons remains on the Xe in an unhybridized d_z orbital. It is pointed out that when invoking the separated electron pair valence bond method that, under certain special conditions, it is possible to have nonparticipation in valence shell hybridization of d orbitals which contain one or a pair of essentially nonbonding electrons. The other theoretical assumption using only the Xe 5p orbitals would lead to an octahedral structure for XeF_6. It is concluded that while a XeF_6 structure based on a pentagonal bipyramidal or distorted octahedral fragment would be conclusive evidence for Xe 5d orbital participation, an octahedral XeF_6 structure should not be construed

as conclusive evidence favoring either Xe 5d orbital participation or the lack of it. (BBB)

39209 EQUILIBRIUM IN THE DEUTERIUM EXCHANGE OF ACETYLENE AND WATER. James W. Pyper and F. A. Long (Cornell Univ., Ithaca, N. Y.). J. Chem. Phys., 41: 1890-6(Oct. 1, 1964).

The isotopic-exchange equilibrium between acetylene gas and deuterated water vapor was experimentally studied over a wide range of deuterium content in the temperature range from 5 to 85°C. The equilibrium constant K_7 for the gas-phase reaction $C_2H_2 + D_2O = C_2D_2 + H_2O$ is 0.473 ± 0.008 at 25°C. The thermodynamic parameters for the reaction are $\Delta H^\circ = 0.29$ kcal/mole and $\Delta S^\circ = -0.56$ eu at 25°C. The equilibrium constant for the disproportionation reaction $C_2H_2 + C_2D_2 = 2C_2HD$ was also measured and was found to have a constant value of 3.95 ± 0.10 for the temperature range 5 to 85°C. The exchange constant K_7 was calculated from the available spectroscopic data for the relevant acetylene and water species and the theoretical values agree with the experimental values to within 10%. The observed data for both the exchange and disproportionation reactions are consistent with those for similar systems. (auth)

39210 THEORY OF NUCLEAR HYPERFINE BROADENING OF ESR LINES IN LIQUIDS. Daniel Kivelson (Univ. of California, Los Angeles). J. Chem. Phys., 41: 1904-9 (Oct. 1, 1964).

The theory of the broadening of ESR spectral lines arising from fluctuations in the isotropic and anisotropic g factors and hyperfine tensors is discussed. Particular attention is paid to the case where the molecule has several equivalent nuclei and the spectrum, therefore, has degenerate lines, i.e., several transitions of the same frequency corresponding to different nuclear states. A mean linewidth T_{2Y}^{-1} is calculated for each degnerate set, and the significance of this quantity is discussed. Certain special cases where the relaxation matrix is diagonal in a spin-state basis are discussed, and the linewidths for each component line of the degenerate set is obtained. The Redfield and the Kubo and Tomita theories are compared, and the limitations of the latter in dealing with degenerate lines is analyzed. (auth)

39211 ABSORPTION, FLUORESCENCE, AND ENERGY LEVELS OF Ho^{3+} IN HEXAGONAL $LaCl_3$. G. H. Dieke and B. Pandey (John Hopkins Univ., Baltimore). J. Chem. Phys., 41: 1952-69(Oct. 1, 1964).

The absorption and fluorescence spectrum of Ho^{3+} in $LaCl_3$ was obtained between 2600 and 12,000 Å and the energy levels established. The Stark components are virtually complete, except for the high-lying levels where, because of crowding and weak absorption, the interpretation becomes uncertain. The observed crystal field splittings for the low-lying levels agree reasonably well with calculated ones if $B_2^0 = 122$, $B_4^0 = -45$, $B_6^0 = -28$, $B_6^6 = 280$ cm^{-1}. Zeeman effects for fields parallel and perpendicular to the axis were obtained and used for the classification. Approximately 180 absorption and 380 fluorescence lines were obtained. A considerable number of the former show resolved nuclear hyperfine structure. The mechanism for energy transfer between excited states was cleared up. (auth)

39212 PARAMAGNETIC RESONANCE OF RARE-EARTH IONS IN YCl_3 AND $LuCl_3$. G. Garton, M. T. Hutchings, R. Shore, and W. P. Wolf (Oxford Univ.). J. Chem. Phys., 41: 1970-82(Oct. 1, 1964).

The principal g values of the ground-state doublets of Dy^{3+}, Er^{3+}, and Yb^{3+} in monoclinic YCl_3 and $LuCl_3$ were measured using EPR at 9.6 kMc/sec and 4.2°K. The results show little variation between the two host lattices, indicating their use for the interpretation of the bulk properties of the concentrated trichlorides. The principal g values of Ce^{3+} and Nd^{3+} in YCl_3 were also measured. It was found that the g values may be accounted for to a first approximation by a distorted octahedral cubic crystal field. (auth)

39213 ENERGY TRANSFER BETWEEN MOLECULES AND ELECTRONICALLY EXCITED ATOMS. M. M. Shahin and S. R. Lipsky (Yale Univ., New Haven). J. Chem. Phys., 41: 2021-6(Oct. 1, 1964).

The technique of competitive quenching was used to determine the relative rate constants of O_2, N_2, H_2, CO_2, and CH_4 for quenching of excited argon atoms formed both by the action of β radiation from a tritium source and also by low-energy electron impact. Calculations based on the mean lifetime of these species in the system show that with the exception of nitrogen the quenching process for all the other molecules is highly efficient and energy transfer occurs on every collision. Evidence is also presented to suggest that the excited species formed by collision with β rays are primarily in the $^1P_1$ state and not the $^3P_{0,2}$ metastable states. (auth)

39214 CALCULATION OF THERMODYNAMIC PROPERTIES OF FUSED SALTS FROM A RIGID-SPHERE EQUATION OF STATE. S. J. Yosim and B. B. Owens (Atomics International, Canoga Park, Calif.). J. Chem. Phys., 41: 2032-6(Oct. 1, 1964).

A rigid-sphere equation of state developed by Reiss, Frisch, and Lebowitz was used as a starting point for the development of expressions for the absolute entropy, entropy of fusion, heat capacity, and compressibilities of molten alkali halides. The absolute entropy of 2 moles of rigid spheres, compressed to the volume of the fused salt, was found to be equal to that of the molten salt. The entropy of compressing these rigid spheres from the molar volume of the liquid to the volume of the solid was in good agreement with the entropy of fusion of fused alkali halides. The heat capacity calculated by the differentiation of the expression for the absolute entropy, at constant pressure of the liquid, was also in good agreement with experimental values. However, the agreement between the calculated compressibility and the experimental results was not good. (auth)

39215 ISOTOPE EFFECT IN THE IONIZATION OF POLYATOMIC GASES BY METASTABLE ATOMS. William P. Jesse (St. Procopius Coll., Lisle, Ill.). J. Chem. Phys., 41: 2060-7(Oct. 1, 1964). (TID-20731)

An isotope effect in the probability of ionizing a polyatomic molecule by energy transfer from a metastable noble-gas atom was investigated for a large number of gases, especially in an attempt to relate the magnitude of the observed effect to the quantity of energy transferred from the metastable atom. In the experiments the current in an ionization chamber was measured for an initially highly purified noble gas under bombardment by beta particles from a ^{63}Ni or ^3H source, as successive measured concentrations (up to 1% by volume) of the gas investigated were introduced. The increase in ionization, relative to that found initially in the pure noble gas, gives a measure of the number of ion pairs resulting from collisions of the second kind between metastable atoms and molecules of the contaminant gas. This relative increase varies through wide limits with the nature of the polyatomic contaminant gas introduced. Moreover, the increase is found consistently larger for a fully deuterated hydrocarbon sample than for an undeuterated one. The isotope ratio, i.e., the ratio of the current increase for a deuterated to

that for an undeuterated sample, was found in ethylene, n-butane, benzene, and toluene to decrease as the metastable state energy increases (in benzene from a ratio 1.16 for an energy of 9.4 ev to 1.04 at 20.2 ev). Over a smaller range, ethane and methane show increases in the ratio with increasing energy. In general, the present values for this isotope ratio are in good accord with the theory of Platzman, which predicted such an isotope effect. (auth)

39216 REMARKS ON THE DETERMINATION OF ELECTRIC DIPOLE MOMENTS FROM ROTATIONAL MAGNETIC MOMENTS. THE DIPOLE MOMENT OF HYDROGEN FLUORIDE. Sunney I. Chan (California Inst. of Tech., Pasadena), Dennis Ikenberry, and T. P. Das. J. Chem. Phys., 41: 2107-10(Oct. 1, 1964).

The determination of electric dipole moments from isotopic variations of the rotational magnetic moment is considered. It is pointed out that appreciable errors in the dipole moment can result if the effects of vibrational motion on the high-frequency part of the magnetic susceptibility are neglected. Thus, a current discrepancy in the dipole moment of HF determined from the rotational magnetic moments of HF and DF and by the molecular beam electric resonance method is resolved by such vibrational corrections. When these vibrational corrections are made, the dipole moment of HF as determined from the rotational magnetic moments of HF and DF is 1.83 ± 0.05 D (H^+F^-) instead of 1.65 D, and is in good agreement with the value of 1.818 ± 0.008 D obtained by electric resonance. (auth)

39217 CALCULATION OF THE FIELD GRADIENT AT THE DEUTERON IN FORMALDEHYDE. J. T. Lowe and W. H. Flygare (Univ. of Illinois, Urbana). J. Chem. Phys., 41: 2153-8(Oct. 1, 1964).

The best available approximate Hartree-Fock electronic wavefunctions were used to compute the field gradient at the deuteron in formaldehyde. The calculated values of the principal field-gradient tensor elements are (all in units of esu cm^{-3})$q_{\alpha\alpha}$(C–H bond axis) = 8.769×10^{14}, $q_{\beta\beta} = -4.783 \times 10^{14}$, and $q_{\gamma\gamma}$(perpendicular to molecular plane) = -3.986×10^{14}. The calculated values of the principal field-gradient tensor elements all lie within the experimental error of the measured quantities. (auth)

39218 HYDROGEN ISOTOPE DISPROPORTIONATION REACTION FOR WATER. James W. Pyper and F. A. Long (Cornell Univ., Ithaca, N. Y.). J. Chem. Phys., 41: 2213-14(Oct. 1, 1964).

It is shown that indirect experimental data support the geometric mean value of 4 for the equilibrium constant K_1 at 25°C for the reaction $H_2O + D_2O = 2HOD$ even though calculations using the latest and most complete spectroscopic data do not. This in turn serves to emphasize some of the difficulties in calculating accurate hydrogen isotope effects from such spectroscopic data. It is illustrated that K_1 values of 3.96 or 4.0 lead to K_f values that are independent of deuterium concentration as expected. The results offer strong support to the proposal that at 25°C K_1 has virtually attained the value 4. (P.C.H.)

39219 MAGNETIC ANALYSIS OF ELASTIC AND REACTIVE SCATTERING IN CROSSED MOLECULAR BEAMS OF K ATOMS WITH CH_3I, Br_2, AND ICl. R. R. Herm, R. Gordon, and D. R. Herschbach (Harvard Univ., Cambridge, Mass.). J. Chem. Phys., 41: 2218-19(Oct. 1, 1964).

A magnetic deflection experiment that eliminates most of the background signal due to the paramagnetic atoms and thus permits a direct measurement of the distribution of the diamagnetic molecules produced by reactive scattering is described. The results verify for three reactions the product distributions that were derived from the two-filament method and also establish some additional features. The results for reactions of K with CH_3I, Br_2, and ICl are compared, and those for the nonreactive system K + cyclohexane are given. (P.C.H.)

39220 ANHYDROUS URANYL NITRATE AND ITS COMPLEXES WITH SOME OXYGEN AND NITROGEN DONORS. C. C. Addison, H. A. J. Champ, N. Hodge, and A. H. Norbury (Nottingham Univ., Eng.). J. Chem. Soc., 2354-60(July 1964).

Reactions of uranium metal with mixtures of dinitrogen tetroxide and nitromethane, aliphatic esters, or methyl cyanide are described. The reactivity of mixtures containing esters varies widely with the ester used. From these reactions, the addition compounds $UO_2(NO_3)_2,N_2O_4$, $UO_2(NO_3)_2,2MeCO_2Et$, and $UO_2(NO_3)_2,2MeCN$ were isolated. The thermal decomposition of the first two of these products was studied by means of thermogravimetric and differential thermal analysis, and conditions are outlined for the isolation of pure anhydrous uranyl nitrate from the dinitrogen tetroxide addition compound. The ultraviolet and infrared spectra of these compounds were compared with those of uranyl nitrate. (auth)

39221 CHROMATOGRAPHIC STUDIES ON THE HYDROLYSIS OF CARBIDES. PART I. THE PREPARATION AND HYDROLYSIS OF RARE EARTH DICARBIDES. F. H. Pollard, G. Nickless, and S. Evered (Univ. of Bristol, Eng.). J. Chromatog., 15: 211-22(July 1964).

Four rare-earth dicarbides and an yttrium carbide (average composition $YC_{1.6}$) were prepared and hydrolyzed using water or mineral acids. The hydrolysis products, gaseous hydrocarbons, were determined using gas-liquid chromatography. The preparation from the oxide and carbon appears to proceed via the metal, and the results of hydrolysis are discussed from the nature of the carbide, the primary and subsequent free-radical reaction steps. In particular, the unusual results with nitric acid, due to the chain-terminating properties of nitric acid are mentioned. (auth)

39222 CHROMATOGRAPHIC STUDIES ON THE HYDROLYSIS OF CARBIDES. PART II. THE HYDROLYSIS OF URANIUM CARBIDES. F. H. Pollard, G. Nickless, and S. Evered (Univ. of Bristol, Eng.). J. Chromatog., 15: 223-7(July 1964).

The gaseous products of the hydrolysis of uranium mono- and dicarbides using water, nitric acid, and sulfuric acid at 100° are reported. Gas-liquid chromatography was used to elucidate the products. The results are discussed with a view to justifying the number of hydrocarbon products with respect to the nature of the carbide. (auth)

39223 Fe^{57} MÖSSBAUER EFFECT IN Fe_2B, FeB, AND Fe_3C. Teruya Shinjo (Kyoto Univ.), Fumitake Itoh, Hideo Takaki, Yoji Nakamura, and Naomoto Shikazono. J. Phys. Soc. Japan, 19: 1252(July 1964).

Measurements of the Mössbauer effect of ^{57}Fe in Fe_2B, FeB, and Fe_3C were made to obtain information on the situation of the iron atom in these compounds. The hyperfine field and isomer shift at room temperature, the magnetic moment at 0°K, and the assumed 3d electron numbers are tabulated. (C.E.S.)

39224 DIFFUSION COEFFICIENTS OF Co^{60} AND Ni^{63} IN NaCl CRYSTALS. Yosia Iida and Yuzo Tomono (Tokyo Univ.). J. Phys. Soc. Japan, 19: 1264(July 1964).

The rate of diffusion of ^{60}Co and ^{63}Ni into single crystals of NaCl was measured as a function of temperature. (C.E.S.)

39225 DISSOCIATION ENERGIES AND EXCITATION LEVELS OF ALKALINE-EARTH OXIDES. Tj. Hollander, P. J. Kalff, and C. Th. J. Alkemade (Rijksuniversiteit, Utrecht). J. Quant. Spectr. Radiative Transfer, 4: 577-9 (July-Aug. 1964).

Ambiguity about the dissociation energy of alkaline earth oxides, as derived from flame photometric measurements, originates from the uncertainty with regard to the emitter of the band spectra, the designation and energy of the ground and excited state levels, respectively, the a'-parameter of the atomic resonance lines involved, and the possible side-reactions of these elements in the flame. Possible side-reactions may lead to the formation of hydroxides, which may also give visible band emissions. To clear up these uncertainties, different methods for measuring the dissociation and excitation energies are evaluated. (N.W.R.)

39226 ELECTRON MICROSCOPIC AUTORADIOGRAPHY: A METHOD FOR PRODUCING UNIFORM MONOLAYERS OF SILVER HALIDE CRYSTALS USING CENTRIFUGE SEDIMENTATION. Gosta F. Dohlman, Arvid B. Maunsbach, Lars Hammarstrom, and Lars-Erik Appelgren (Karolinska Institutet, Stockholm). J. Ultrastruct. Res., 10: 293-303(Apr. 1964).

A new method was developed to produce very uniform monolayers of AgBr crystals over ultrathin sections for electron microscopic autoradiography. Diluted nuclear emulsions are centrifuged to sediment its crystals over the sections. By changing the dilution and amount of the centrifuged emulsion, the density of the produced layer can be controlled at will. The position of the grains is secured by a collodion film. The method makes it possible to coat several grids at the same time with a very similar emulsion layer and is reproducible. Various factors that affect the grain distribution were studied. The localization of ^{125}I in the thyroid was studied to test the method. Mice were injected intravenously with 0.25 mC carrier-free ^{125}I. The developed grains demonstrating ^{125}I deposition were almost exclusively found over the colloid, and a very sharp decrease in frequency occurred at the apical cell membranes of the thyroid cells. Although a small percentage of grains was partly located over the cell membrane itself, grains were only rarely seen over the most apical part of the thyroid cell cytoplasm. Colloid showed a fairly uniform distribution of grains, but in some follicles were peripherally located. (BBB)

39227 PREPARING IODIDES OF RARE EARTH METALS. V. A. Oglodkov and S. L. Selivanova (Inst. of General and Inorganic Chemistry, Academy of Sciences, Ukrainian SSR). Khim. Prom., No. 2, 24-5(Apr.-June 1964).

Procedures are described for the preparation of crystal hydrates of iodides of rare earth metals on a laboratory scale by a method based on the reaction of rare earth oxides or their carbonates with hydriodic acid. Samples obtained of erbium, samarium, neodymium, praseodymium, holmium, gadolinium, yttrium, and ytterbium contained the following quantities (% by wt) of iodides of the respective elements: 54.2, 55.0, 55.4, 56.5, 53.4, 55.5, 59.8, and 52.3. Any work with these iodides must be performed in an atmosphere of inert gases due to their affinity for oxygen. (auth)

39228 NUCLEAR ISOMER SHIFT AND COVALENCY IN IRON COMPLEXES. J. Danon (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). Notas Fis., Centro Brasil. Pesquisas Fis., 10: 281-7(1963).

Studies on iron complexes showed that in the spin-paired iron complexes the 3d electrons are more or less delocalized according to the strength of π-bonding between the d_π orbitals of the metal and the appropriate orbitals of the ligands. The spread of the charge cloud of the d electrons due to this covalent bonding will decrease the shielding of the s-electrons and it is thus possible to explain the relatively small isomer shift observed with these complexes. By these arguments the extent of delocalization of d electrons and consequent increase in s-electron density at the iron nucleus should be smaller in Fe(II) $[S_2CN(CH_3)_2]_2NO$ than in $Fe(CN)_5NO$, which is in agreement with the isomer shift values for these complexes. (P.C.H.)

39229 CHEMICAL EVIDENCE FOR THE EXISTENCE OF NON-BASAL DISLOCATIONS IN GRAPHITE. J. M. Thomas, C. Roscoe, K. M. Jones, and G. D. Renshaw (University Coll. of North Wales, Bangor). Phil. Mag. (8), 10: 325-30(Aug. 1964).

Highly purified graphite samples were examined by electron microscopy after oxidation by oxygen or a mixture of oxygen and carbon dioxide at temperatures between 800 and 830°C. The distribution and nature of the etch pits observed on the cleavage surfaces indicated the presence of nonbasal dislocations contributing to etch-pit production. (D.C.W.)

39230 LOW TEMPERATURE MAGNETIC TRANSITIONS IN LANTHANON TRICHLORIDES. J. C. Eisenstein, R. P. Hudson, and B. W. Mangum (National Bureau of Standards, Washington, D. C.). Phys. Letters, 12: 5 (Sept. 1, 1964).

Measurements of the a-c susceptibility and specific heat of $NdCl_3$, $CeCl_3$, and $PrCl_3$ revealed anomalous peaks in the susceptibility, which were suppressed by a d-c magnetic field, and anomalously large specific heats well below 1°K. The specific heats are not simply correlated with the position of the magnetic anomalies. An explanation in terms of superexchange interactions between nearest neighbor and next nearest neighbor lanthanide ions is proposed. (D.C.W.)

39231 ELECTRONIC SPECTRA OF CRYSTALLINE GERMANIUM AND SILICON. David Brust (Argonne National Lab., Ill.). Phys. Rev., 134: A1337-53(June 1, 1964).

A detailed calculation of the energy bands of germanium and silicon was performed by use of the pseudopotential method. The first three potential coefficients were determined empirically, and all higher ones set equal to zero. This potential was used to compute the energy eigenvalues at ~50,000 points throughout the Brillouin zone. By use of this sample, the imaginary part of the dielectric constant was calculated in the optical and near ultraviolet where direct transitions between the valence and low-lying conduction bands dominate the response. Photoelectric yield curves were obtained for comparison with recent experiments. In all cases agreement of theory and experiment was reasonable. Energy contours were constructed in several of the principal symmetry planes. These were used to explain the structure in the optical properties of Ge and Si in terms of transitions near certain important critical points. Effective masses and the static dielectric constant were also computed. (auth)

39232 ELECTRONIC SHIELDING BY CLOSED SHELLS IN SALTS OF THULIUM. R. G. Barnes (California Inst. of Tech., Pasadena and Iowa State Univ., Ames), R. L. Moess-

bauer, E. Kankeleit, and J. M. Poindexter. Phys. Rev., 136: A175-89(Oct. 5, 1964). (IS-920)

Electronic shielding by closed electron shells was investigated in salts of trivalent thulium, by measuring the temperature dependence of the nuclear quadrupole splitting of the 8.42-kev gamma transition in ^{169}Tm. The measurements were performed by using the technique of recoilless nuclear resonance absorption. The nuclear quadrupole interaction was studied for Tm^{3+} ions in thulium ethyl sulfate, thulium oxide, and thulium trifluoride within a temperature range from 9.6 to 1970°K. The interpretation of the experimental data in terms of the contributions of distorted closed electron shells to the quadrupole interaction yields values for electronic shielding factors. The results lead to amounts of 10% or less for the atomic Sternheimer factor R_Q. The experiments also reveal substantial shielding of the 4f electrons from the crystal electric field, expressed by the shielding factor σ_2. Values of 250 and 130 are obtained for the ratio $(1 - \gamma_\infty)/(1 - \sigma_2)$ for thulium ethyl sulfate and thulium oxide, respectively, where γ_∞ is the lattice Sternheimer factor. (auth)

39233 ELECTRON HALL MOBILITY IN THE ALKALI HALIDES. R. K. Ahrenkiel and Frederick C. Brown (Univ. of Illinois, Urbana). Phys. Rev., 136: A223-31(Oct. 5, 1964).

New results are presented on the mobility of electrons in alkali-halide crystals down to the temperature of liquid helium. An improved technique was used to observe the transient Hall effect for electrons released from color centers by light. Optical-mode scattering with mobility dependent upon exp (Θ/T) was generally observed above 40°K. The Debye temperature Θ can be compared with the optical-mode frequency of the material, whereas the magnitude of the scattering can be used to estimate band and polaron mass parameters. Mobilities as high as 15000 $cm^2/v\text{-}sec$, depending upon F-center density, were observed for lightly colored crystals of KBr at 7°K. Similar high mobilities were found for KI and a sample of zone-refined KCl, but the largest mobility observed in NaCl was 1200 $cm^2/v\text{-}sec$. The low-temperature mobility in KBr could reduce an order of magnitude by optically converting F centers (neutral defects) to F′ and α centers (charged defects). The original mobility could then be restored by illumination in the F′ band at low temperature. (auth)

39234 PARAMAGNETIC RESONANCE OF Fe^{3+} AND Gd^{3+} IN YTTRIUM ORTHOALUMINATE. R. L. White (Stanford Univ., Calif.), G. F. Herrmann, J. W. Carson, and M. Mandel. Phys. Rev., 136: A231-9(Oct. 5, 1964).

The paramagnetic-resonance spectra of Fe^{3+} and Gd^{3+} in yttrium orthoaluminate were measured as part of an effort directed at understanding the isomorphic orthoferrites. The low symmetry of the ion sites and the complicated nature of the spectra necessitated the development of a special method of analysis for obtaining the relevant spin hamiltonians. The method consisted of constructing directly from the angular dependence of the data anisotropy surfaces, classical counterparts of the spin hamiltonian, from which the spin hamiltonian itself could be extracted by the method of operator equivalents. The predominant term in both Fe^{3+} and Gd^{3+} hamiltonians was quadratic in the spin components. The fourth-order term of the Fe^{3+} hamiltonian manifested very nearly cubic symmetry with the biquadratic coefficient a negative, contrary to general expectations. The Gd^{3+} spin hamiltonian displayed no visible cubicity in the fourth-order terms. The preferred spin directions as determined in the orthoaluminate were compared with the observed spin configurations in the orthoferrites, and with the predictions of crystal-field calculations based on the ion position parameters of $GdFeO_3$. Correlation was very poor in both instances. No conclusive explanation of the discrepancies is at present available; the most likely explanation involved differences in the local crystal distortions between the orthoaluminate and the orthoferrite. (auth)

39235 CALCULATION OF F-BAND PEAK ENERGY IN CsF. William A. Smith Jr. (Edgerton, Germeshausen and Grier, Inc., Santa Barbara Div., Goleta, Calif.). Phys. Rev., 136: A243-4(Oct. 5, 1964). (EGG-1183-2000)

A calculation of the F-band peak energy in CsF was made using a quantum-mechanical self-consistent-field method of the variation type. This calculation gave a value of 1.71 ev for the CsF absorption-band peak. This result is only 2.3% lower than the 1.75-ev peak of the triplet absorption measured by Hughes and Rabin in x-ray colored CsF crystals. Similar calculations were made for F-band peaks in LiF, NaF, KF, and RbF, and numerical results are presented. Comparison of existing experimental data on the alkali fluorides and the present theoretical results lends credence to the suggestion made by Hughes and Rabin that the triplet absorption at 1.95, 1.86, and 1.75 ev in CsF is due to the F center. The absorption peak observed at 2.18 ev in CsF could not be considered as a candidate for the F-band, since it is 21.5% higher than the calculated value. (auth)

39236 PHONON-INDUCED RELAXATION IN EXCITED OPTICAL STATES OF TRIVALENT PRASEODYMIUM IN LaF_3. W. M. Yen, W. C. Scott, and A. L. Schawlow (Stanford Univ., Calif.). Phys. Rev., 136: A271-83(Oct. 5, 1964).

Phonon-ion interactions were recently shown to satisfactorily explain the temperature dependence of widths and positions of the R lines of some 3d ions in crystals. These interactions give rise to phonon relaxation processes and are investigated as the mechanisms responsible for the widths and positions of sharp optical transitions in (4f) ions, in particular $LaF_3:Pr^{3+}$. The widths of transitions originating or terminating in the metastable $^3P_0$ state and involving the $^3H_4$, $^3H_6$, $^3F_2$, and $^3F_4$ states of Pr^{3+} in LaF_3 were investigated as a function of temperature and are found to be both qualitatively and quantitatively explainable in terms of lifetime broadening of the interacting states via nonradiative processes. Temperature-dependent shifts were also measured for the four groups of transitions and are shown to be in qualitative agreement with theoretical predictions. Additional features of the $LaF_3:Pr^{3+}$ spectrum, including several unreported weak transitions and vibrational sidebands, are also reported. (auth)

39237 SPIN CORRELATIONS IN MnO. I. A. Blech and B. L. Averbach (Massachusetts Inst. of Tech., Cambridge). Physics, 1: 31-44(July-Aug. 1964).

Spin correlations were investigated in powder samples of MnO above and below the Neel temperature by means of diffuse neutron scattering measurements. There is a significant local order above T_N, with the spins coupled in an antiferromagnetic fashion and tending to lie parallel to {111} planes. This layer structure suggests a second neighbor interaction energy, with $V_2 = 4.9 \times 10^{-3}$ ev and with the exchange interaction $J_2 = -4.6°$. There was no evidence for an extra total scattering in the vicinity of the critical temperature. (auth)

39238 VALIDITY OF SOME APPROXIMATION PROCEDURES USED IN THE THEORETICAL CALCULATION

OF ISOTOPE EFFECTS. M. Wolfsberg and M. J. Stern (Brookhaven National Lab., Upton, N. Y. and Columbia Univ., New York). Pure Appl. Chem., 8: 225-42(1964). (BNL-7621)

Computer programs for the evaluation of kinetic isotope effects, on the basis of given reactant and transition state force fields, have been employed to study some of the approximation procedures that have been used in the theoretical treatment of isotope effects. The general danger of just considering one part or another of the theoretical equations is pointed out. The interplay of the three factors that make up the equation for the isotopic ratio k1/k2 suggests further search for expansion methods that express the isotope effect even at room temperature directly in terms of force constants, geometries, and masses. The high temperature equation and the so-called gamma-bar equation were found of great qualitative utility, but there exists some question about their general quantitative usefulness in the room temperature region at present. Difficulties involved in obtaining the isotopic frequency ratio of the decomposition frequencies from room temperature region experiments are pointed out. Indications were obtained that the isotope effects for very large molecular systems can be studied theoretically by working with smaller molecules. (P.C.H.)

39239 SOLVENT ISOTOPE EFFECT IN H_2O-D_2O MIXTURES. A. J. Kresge (Illinois Inst. of Tech., Chicago). Pure Appl. Chem., 8: 243-58(1964).

The relations of previous treatments of the Gross-Butler phenomenon to one another and under what conditions the conclusions drawn from them are valid are discussed. The derivation of a general equation, application to equilibria, and application to kinetics are included. (P.C.H.)

39240 DEUTERIUM SOLVENT ISOTOPE EFFECTS ON ACID-BASE EQUILIBRIA IN DIOXAN-WATER MIXTURES. V. Gold and B. M. Lowe (London Univ.). Pure Appl. Chem., 8: 273-9(1964).

Studies were made on the dissociation of water and acetic acid in D_2O-dioxane and H_2O-dioxane. The results show that both isotope effects vary only slowly, decreasing as the mole fraction of dioxane in the solvent is raised, at least up to the compositions studied. The practical implication of the results is that dioxane-water mixtures are admissible as media for the study of deuterium solvent isotope effects. The results also dispose of the facile prediction that the isotope effect might be more marked in the mixtures with dioxane, on the fallacious reasoning that smaller acid dissociation constants are generally associated with more pronounced isotope effects. (P.C.H.)

39241 SECONDARY ISOTOPE EFFECTS AS PROBES FOR FORCE CONSTANT CHANGES. M. Wolfsberg and M. J. Stern (Brookhaven National Lab., Upton, N. Y. and Columbia Univ., New York). Pure Appl. Chem., 8: 325-38(1964). (BNL-7619)

It is shown that, in the absence of any differences between reactant and transition state in the force field or in the geometry directly involving the isotopic position, the secondary isotope effect is well approximated by the classical limit $\nu_{1L}^{+}/\nu_{2L}^{+}$ even at room temperature. When there are force constant changes in coordinates involving the isotopic position, there will be an isotope effect, the magnitude of which depends on the magnitude of the changes. A general decrease of these force constants in going to the transition state will lead to normal isotope effects [k (light)/k (heavy) > 1] while an increase in force constants will generally lead to inverse effects. Different transition state geometries will generally only require slightly different transition state force fields (involving the isotopically substituted position) in order to yield the same isotope effects in the room temperature region. It is proposed that secondary isotope effects serve largely as probes for force constant differences at the isotopic position between reactant and transition state. It is emphasized that other knowledge may, of course, relate force constants to geometry. The temperature dependence of secondary isotope effects need not yield pre-exponential Arrhenius factors of just 1000. The actual value of this factor may indeed give some clue about force field changes. In general, however, if experimental at only one temperature is possessed, it will be very difficult to bracket the cause of the isotope effect. Secondary carbon isotope effects may yield very important information about the decomposition motion. (P.C.H.)

39242 SECONDARY ISOTOPE EFFECTS ON PI-COMPLEX FORMATION. E. A. Halevi and B. Ravid (Israel Inst. of Tech., Haifa). Pure Appl. Chem., 8: 339-45(1964).

Kinetic isotope effects determined previously by Olah, Kuhn, and Flood (J. Am. Chem. Soc., 83: 4571(1961)) were qualitatively reproduced in a system at equilibrium. All the results discussed are consistent with the interpretation of isotope effect in nitration, and with the re-formulation of the role of the hyperconjugation in electron-deficient systems, which resolves the apparent contradiction between the direction of secondary isotope effects on the formation of superficially similar pi-complexes with acceptors of different types. These would be very difficult to rationalize in the conventional interpretation of hyperconjugative electron release, or—if it is kept in mind that both the chloranil and HCl complexes were studied in the non-polar solvents cyclohexane and methylcyclohexane—by an invocation of steric hindrance to solvation. (P.C.H.)

39243 STERIC ORIGIN OF SOME SECONDARY ISOTOPE EFFECTS. V. F. Raaen and C. J. Collins (Oak Ridge National Lab., Tenn.). Pure Appl. Chem., 8: 347-55(1964).

Methods used for the determination of secondary deuterium isotope effects are discussed. Errors, often duplicable, that can be misleading with respect to both the magnitude and direction of the isotope effect are mentioned. (P.C.H.)

39244 CARBON-14 AND TRITIUM ISOTOPE EFFECTS IN HOFMANN DEGRADATION OF QUATERNARY AMINES. H. Simon and G. Muellhofer (Technische Hochschule, Munich). Pure Appl. Chem., 8: 379-84(1964).

The ^{14}C and tritium isotope effects were determined in the Hofmann degradation of several quaternary ammonium hydroxides. Three methods were used. In every case a clear effect was found, proving that the C-N bond rupture occurs in the rate-determining step. The results are in good agreement with previously reported ^{15}N isotope effects. (P.C.H.)

39245 INTRAMOLECULAR PROTON EXCHANGE IN AROMATIC CARBONIUM IONS: ISOTOPE EFFECT IN HEXAMETHYLBENZENE. E. L. Mackor and C. MacLean (Koninklijke Shell-Laboratorium, Amsterdam). Pure Appl. Chem., 8: 393-404(1964).

The NMR spectra of hexamethylbenzene were measured in deuterium fluoride in order to study the isotope effect. From the NMR and other spectroscopic data the picture of the structure of the hexamethylbenzene proton complex was determined. The transfer of the proton between two adja-

cent carbon atoms of the nucleus of protonated hexamethylbenzene requires considerable activation (12 kcal/mole) and has a surprisingly high frequency factor ($\sim 10^{14}$). The transfer of the proton is a complicated process during which there are also considerable displacements of methyl groups as well as changes in length of the carbon–carbon bonds of the nucleus. The transfer of the proton along the reaction coordinate is, therefore, most likely to be coupled with the out-of-plane modes of the methyl groups and the stretching modes of the carbon–carbon bonds of the nucleus. It is expected that the mass of the particle along the reaction coordinate will exceed that of the mass of the proton considerably, which will tend to make the measured isotope effect smaller. (P.C.H.)

39246 KINETIC HYDROGEN ISOTOPE EFFECTS IN THE HYDRATION OF ISOBUTENE. V. Gold and M. A. Kessick (London Univ.). Pure Appl. Chem., 8: 421-5(1964).

Kinetic hydrogen isotope effects in the hydration of isobutene in aqueous solution of perchloric acid were measured by the direct comparison of reaction velocities and by the observation of relative isotopic abundances in the product (or in the unchanged starting material). The results clearly established the existence of an isotope effect in the hydration of isobutene, as a result of which the entry of lighter hydrogen isotopes is favored relative to heavier ones. From theoretical analysis, it is suggested that the rate-controlling step of the reaction is a slow proton transfer from H_3O^+. (P.C.H.)

39247 THE ADSORPTION AND SEDIMENTATION OF CLEAN, CARRIER-FREE, YTTRIUM SOLUTIONS. C. E. Mellish, J. A. Payne and G. Worrall (Wantage Research Lab., Berks, Eng.). Radiochim. Acta, 2: 204-10(July 1964).

Experiments on the adsorption and sedimentation of yttrium solutions were carried out with solutions containing minimal suspended matter. It was found that such clean solutions of carrier-free yttrium can be kept in polystyrene vessels, even at pH = 8 or more, with no sedimentation taking place, and only a small amount of adsorption on to the vessel walls. It was also found that addition of Analar water to such solutions converts the yttrium to a centrifugable form. It is suggested that the radiocolloidal properties of yttrium reported in the literature are due to ion exchange adsorption of yttrium ions on to suspended particulate matter and on to surfaces. (auth)

39248 PROTACTINIUM FLUORIDES, THE NEW CLASS, $MPaF_6$. L. B. Asprey and R. A. Penneman (Los Alamos Scientific Lab., N. Mex.). Science, 145: 924(Aug. 28, 1964). (LADC-6371)

Complex fluorides of protactinium having a Pa/M ratio of one (where M = K, Rb, or NH_3) were prepared from concentrated solutions of HF. The $MPaF_6$ compounds are isostructural with the corresponding compounds of pentavalent uranium but not with the tantalum analogs. The size of protactinium (V) is but slightly larger than that of uranium(V). (auth)

39249 PLUTONIUM DIOXIDE: PREPARATION OF SINGLE CRYSTALS. K. D. Phipps and D. B. Sullenger (Monsanto Research Corp., Miamisburg, Ohio). Science, 145: 1048-9(Sept. 4, 1964).

Well-formed single crystals of plutonium dioxide were precipitated from a silicate glass and examined as an inclusion in a glass fiber drawn from the parent material. (auth)

39250 ELECTRON MICROSCOPY OF METEORITIC AND ARTIFICIALLY SHOCKED GRAPHITE. Thomas P. Sciacca (Goddard Space Flight Center, Greenbelt, Md.) and Michael E. Lipschutz. Science, 145: 1049-50(Sept. 4, 1964).

Samples of graphite, partly converted to diamond by shock, and meteoritic graphite were studied by transmission electron microscopy. The shocked graphite remained in the form of single crystals and was mildly deformed, while the diamond that had formed was anhedral and polycrystalline. The meteoritic graphite contained minor amounts of troilite (FeS) and elemental sulfur, but no detectable carbon phase other than graphite. (auth)

39251 RAOULT'S LAW STUDY OF VANADIUM PENTAFLUORIDE IN URANIUM HEXAFLUORIDE. Reynard C. Shrewsberry (Union Carbide Nuclear Co., Paducah, Ky.) and Boris Musulin. Science, 145: 1452-4(Sept. 25, 1964).

Binary systems of liquid vanadium pentafluoride dissolved in liquid uranium hexafluoride are non-ideal, with negative deviations from Raoult's law in the temperature range 75 to 92°C. (auth)

39252 VAPOR PRESSURE OF ICE CONTAINING D_2O. Sadao Matsuo, Hideko Kuniyoshi, and Yasuo Miyake (Tokyo Kyoiku Univ.). Science, 145: 1454-5(Sept. 25, 1964).

The vapor pressures of solid D_2O and ice containing D_2O in various amounts were measured with an oil manometer. The result gives the lowest vapor pressure for D_2O ice ever obtained. The observed value for ice with different proportions of D_2O and H_2O agreed well with the values calculated on the assumption that the vapor pressure of HDO is the geometrical mean of those of H_2O and D_2O and that the equilibrium constant of isotopic exchange is 4. The fractionation factor of D between ice and vapor phases increases from 1.128 at 0°C to 1.210 at –38°C. (auth)

39253 EFFECTS OF THERMAL MOTION ON THE POTENTIAL DISTRIBUTION FOR AN ATOM. V. F. Dvoryankin (Inst. of Inorganic Chemistry, Academy of Sciences, Siberian SSR). Soviet Phys. Cryst. (English Transl.), 9: 13-16(July-Aug. 1964). Translated from Kristallografiya, 9: 20-5(Jan.-Feb. 1964).

Convolution of the potential $\varphi(r)$ with the Fourier transform for the isotropic temperature factor was used to derive an expression for the potential distribution for a moving atom. The general formulas are applied to the hydrogen atom. (auth)

39254 EFFECTS OF THERMAL MOTION ON THE POTENTIAL DISTRIBUTION FOR THE HYDROGEN ATOM. V. F. Dvoryankin and V. N. Kolomiichuk (Inst. of Inorganic Chemistry, Academy of Sciences, Siberian SSR). Soveit Phys. Cryst. (English Transl.), 9: 17-21(July-Aug. 1964). Translated from Kristallografiya, 9: 26-31(Jan.-Feb. 1964).

A theoretical calculation is presented for the potential distribution of the hydrogen atom for various values of $(\sin\vartheta/\lambda)_{max}$ and of the isotropic temperature factor. (auth)

39255 COPRECIPITATION STUDIES OF SOME TERVALENT METAL IONS WITH ALUMINIUM TRIS-(8-HYDROXYQUINOLATE). S. J. Lyle and D. L. Southern (Univ. of Durham, Eng.). Talanta, 11: 1239-48(Aug. 1964).

The coprecipitation of tracer quantities of radioactive scandium, yttrium, cerium, and indium with milligram-quantities of aluminum was studied. The aluminum was precipitated as the tris-(8-hydroxyquinolate) by slow isothermal evaporation of aqueous acetone solutions. In the presence of ammonium acetate less than 0.5% of the scandium, yttrium, or cerium coprecipitates. The fraction of tracer entrained is approximately independent of the fraction of the aluminum precipitated. Surface adsorption of

tracer on the glass container or on the precipitate does not occur even when all of the acetone had been removed. Milligram-quantities of yttrium and cerium give gelatinous precipitates from similar systems containing acetone (aluminum absent); the dried yttrium precipitate has the composition $Y(C_9H_6NO)_2 \cdot OCOCH_3$. Even milligram-quantities of yttrium, when present, tend to be rejected by the aluminum precipitate. In the absence of acetate but under conditions where milligram-amounts of yttrium would precipitate, for 10 to 90% precipitation of the aluminum, yttrium coprecipitation ranges from 1 to 6%. Removal of all of the acetone results in considerable surface adsorption of the tracer. From acetate solutions fractional precipitation of indium as tracer in the range 10 to 90% is only slightly different (lower) than the corresponding fractional precipitation of the aluminum. D and λ, the coefficients calculated assuming a homogeneous and a logarithmic distribution, respectively, within the crystals, are approximately equal and constant. Milligram-amounts of indium give a granular precipitate by the slow evaporation procedure from acetate solutions. (auth)

39256 THE PREPARATION OF CERIUM-IV HYDROXIDE FROM AMMONIUM HEXA-NITRATOCERATE BY EMPLOYING KINETICALLY CONTROLLED PRECIPITATION THROUGH UREA HYDROLYSIS. G. Frederick Smith (Univ. of Illinois, Urbana). Talanta, 11: 1272-3(Aug. 1964).

The preparation of cerium(IV) hydroxide by kinetically controlled precipitation through use of the hydrolysis of urea and its reaction with ammonium hexanitratocerate is described. The air-dried product thus obtained is of fine-mesh particle size and is readily soluble in hot dilute sulfuric acid to form solutions of sulfatoceric acid, $H_2Ce(SO_4)_3$, for oxidimetric titrations. (auth)

39257 HIGH-TEMPERATURE STABILITY OF TUNGSTEN OXIDE STRUCTURES. Bert Phillips and Luke L. Y. Chang (Tem-Pres Research, Inc., State College, Penna.). Trans. AIME, 230: 1203-6(Aug. 1964).

Various compositions of tungsten–oxygen systems were sealed in nonreactive containers such that only a small gas volume remained. Each sample then established its own equilibrium atmosphere at any selected temperature. The phase diagram resulting from these experiments is shown. It was concluded that an increase in either the selected temperature or oxygen content of the mixture caused an increase in the oxygen pressure and total pressure necessary for preservation of equilibrium. (M.C.G.)

39258 A NEW URANYL TRICARBONATE, $K_2Ca_3(UO_2)_2(CO_3)_6 \cdot 9\text{-}10H_2O$. Robert Meyrowitz, Daphne R. Ross, and Malcolm Ross. U. S. Geol. Surv. Profess. Papers, No. 501, B82-3(1964).

A new uranyl tricarbonate, $K_2Ca_3(UO_2)_2(CO_3)_6 \cdot 9\text{-}10H_2O$ was synthesized using $UO_2(NO_3)_2 \cdot 6H_2O$, K_2CO_3, and $Ca(NO_3)_2 \cdot 4H_2O$. The green-yellow crystals show parallel extinction. They are biaxial positive, $2V = 20-30°$; $\alpha = 1.544 \pm 0.003$, $\beta = 1.549 \pm 0.003$, and $\gamma = 1.563 \pm 0.003$ (white light). The measured and calculated specific gravities are 2.93 and 3.01 g/cm^3 respectively. The compound is orthorhombic, space group Pnmn (No. 58) or Pn2n (No. 34), with a = 17.98, b = 18.29, c = 16.95 A, V = 5.574 A^3, and Z = 8. Two quantitative chemical analyses and x-ray-powder data are given. (auth)

39259 CESIUM AND STRONTIUM SORPTION STUDIES ON GLAUCONITE. Marian M. Schnepfe, Irving May, and Charles R. Naeser. U. S. Geol. Surv. Profess. Papers, No. 501, B95-9(1964).

Studies of the ion-exchange behavior of cesium and strontium with glauconite in column experiments at pH 3, 6, and 10 indicate that increasing the pH increases the uptake of these ions. The strontium uptake averages 95% of capacity values at pH 10, while the cesium uptake is approximately 50%. Initial acid-treatment of glauconite increases the exchange with cesium to near capacity levels at pH 10, but reduces the strontium uptake by about 30%. (auth)

39260 POTENTIOMETRIC ESTIMATION OF THORIUM AS OXALATE. K. R. K. Rao, A. S. Reddy, and S. R. Mohanty (Banaras Hindu Univ., Varanasi, India). Z. Anal. Chem., 203: 415-17(1964).

An investigation showed that the potentiometric determination of Th as oxalate yields values with a constant error. Thus the method can be employed for analysis with a suitable correction for the end point. (P.C.H.)

39261 ROENTGENOGRAPHIC AND CHEMICAL INVESTIGATION OF URANIUM OXIDES DURING OXIDATION AT 10^{-2} AND 10^{-3} TORR BETWEEN 100 AND 800°C. Siegfried Steeb (Max-Planck-Institut für Metallforschung, Stuttgart). Z. Metallk., 55: 445-52(Aug. 1964). (In German)

A survey was made of the crystal structure data of uranium oxides. Special consideration was given to the results of kinetic measurement. Different phase diagrams in the system U–O are discussed. A critical survey is presented of the x-ray and chemical methods for determination of the O/U ratio. The application of x-ray methods seemed to be not very reasonable due to the lack of reliable calibration curves and other considerations. It is shown, that determination of the O/U ratio with the potentiometric method should be preferred over gravimetric determination. Experiments are discussed in which UO_2 powder was exposed to an oxygen partial pressure of 10^{-2} and 10^{-3} Torr for 8, 16, and 24 hours at 100, 150, 200, 300, 400, 500, 600, 700, and 800°C. Samples in these conditions were investigated by x rays and chemically, the results are discussed, tabulated, and summarized in form of diagrams from which the final condition of the oxygen treatments can be read for the particular temperature, pressure, and time of exposure to the oxygen. (auth)

39262 REACTION OF PLUTONIUM DIOXIDE WITH THE OXIDES OF SOME OF THE NUCLEAR FISSION-PRODUCED ELEMENTS. Cornelius Keller (Technische Hochschule, Karlsruhe, Ger. and Kernforschungszentrum, Karlsruhe, Ger.). Z. Metallk., 55: 466-72(Aug. 1964). (In German)

Several oxide phases and ternary oxides of plutonium with Pu valencies from 3 to 6 were obtained by solid-state reactions of Pu_2O_3 or PuO_2 with oxides of several elements. From the reaction conditions it could be concluded that some of these ternary oxides are formed in oxide fuel elements containing plutonium at high burnup. The properties and the thermal stability of the compounds are discussed. (auth)

39263 INVESTIGATION OF THE MAGNETIC SUSCEPTIBILITY OF ORTHOFERRITES OF THE RARE EARTH ELEMENTS IN STRONG MAGNETIC FIELDS. K. P. Belov, A. M. Kadomtseva, and R. Z. Levitin (Moscow State Univ.). Zh. Eksperim. i Teor. Fiz., 47: 439-43 (Aug. 1964). (In Russian)

The magnetization curves of a number of polycrystalline and single crystal orthoferrites of the rare earth elements are measured in pulsed magnetic fields up to 220 kOe. An

analysis of the magnetic susceptibilities of the orthoferrites studied shows that at room temperature exchange fields of the iron sublattices (as well as other crystal fields), do not affect the magnetic moments of the rare earth ions. Thus at the indicated temperatures the rare earth ions in orthoferrites may be considered as being free in the magnetic sense. (auth)

39264 PRODUCTION OF BERYLLIUM CHLORIDE FROM BERYL ORE. Ricardo O. Bach (to Beryllium Metals and Chemical Corp.). U. S. Patent 3,146,065. Aug. 25, 1964. Filed Nov. 22, 1961.

A process is given for directly producing $BeCl_2$ from the product of fluorination of beryl ores. The process comprises reacting the fluorination product with $SiCl_4$ to form volatile $BeCl_2$ which is easily isolated from the alkali or alkaline earth metal compounds. Other chlorinating agents may be used. Examples of the process are given. (D.L.C.)

Organic Chemistry

39265 QUADRUPOLE NUCLEAR RELAXATION OF DEUTERIUM IN LIQUIDS. R. K. Mazitov (Kazan State Univ.). Dokl. Akad. Nauk SSSR, 156: 418-19(May 11, 1964). (In Russian)

Measurements were made of time-spin-lattice relaxation of T_1 deuterium in 11 molecular liquids. Estimates of magnetic dipole-dipole contributions to the measured T_1 magnitudes showed that they may be disregarded. The relaxation time is determined by quadrupole interactions described by: $1/T_1 = {}^3/_8\ (1 - \eta^2/3)\ (e^2qQ/\hbar)^2\tau_c$, (where η is an assymetry parameter, $2\pi^{-1}(e^2qQ/\hbar)$ is the quadrupole bond constant expressed in Hertz, τ_c is the time correlation of quadrupole interaction. The spin-lattice deuteron relaxations were measured by spin echo at 4.4 Mc. The order of accuracy was ±10% at 20 ± 2°C. The results are tabulated for deuterated ethanol, methanol, benzene, pyridine, and toluene. (R.V.J.)

39266 THE FREE-RADICAL ADDITION OF DEUTERIUM BROMIDE TO CIS- AND TRANS-1-DEUTERIO-1-HEXENE. Philip S. Skell and Peter K. Freeman (Pennsylvania State Univ., University Park). J. Org. Chem., 29: 2524-6(Sept. 1964).

The radical-chain addition of deuterium bromide to a terminal olefin, 1-deuterio-1-hexene, was found to be a stereospecific reaction. (auth)

39267 A SYNTHESIS OF C^{14}-LABELED PYRIDOXOL. C. J. Argoudelis and F. A. Kummerow (Univ. of Illinois, Urbana). J. Org. Chem., 29: 2663-9(Sept. 1964).

Pyridoxol hydrochloride labeled with ^{14}C at the 5-hydroxymethyl group was synthesized. The carbon atom of the 5-hydroxymethyl group of pyridoxol hydrochloride was removed and reintroduced as ^{14}C through the following sequence of reactions: CH_2OH, COOH, $COOCH_3$, $CONH_2$, NH_2, C*N, C*OOH, C^*H_2OH. As high as two-thirds of the specific activity of the ^{14}C-labeled potassium cyanide could be introduced into pyridoxol hydrochloride. The chemical and radiochemical purity of the final product was almost 100% as was shown by column chromatography, paper chromatography (two solvent systems), paper electrophoresis, and isotope dilution assay. (auth)

39268 THE ISOTOPIC SUBSTITUTIONS OF 4-PYRONE. Peter Beak and Glen A. Carls (Univ. of Illinois, Urbana). J. Org. Chem., 29: 2678-81(Sept. 1964).

The treatment of 4-pyrone with deuterium oxide at 98°C for 26 hr led to 4-pyrone-3,5-d_2 as the major volatile product. In corresponding treatment with ^{18}O-enriched water, 4-pyrone incorporated ^{18}O into both the carbonyl group and the heterocyclic ring. These substitutions, in conjunction with the observation that 4-pyrone is not formed from formic acid and acetone under conditions similar to those that yield the isotopic substitution products, indicated that the intermediates in these reactions may be ring opened but not completely cleaved. Other pyrones failed to give incorporations under the same conditions. The infrared spectrum of 4-pyrone-3,5-d_2 established that a Fermi resonance is responsible for the splitting observed in the 1667-cm^{-1} absorption of 4-pyrone. The synthesis of 3,5-dimethyl-4-pyrone was a variant of an earlier synthesis that should make compounds of this type readily available. (auth)

39269 THE SYNTHESIS OF OXETANE-d_6. W. J. Lafferty, R. C. Lord, and D. W. Mayo (Massachusetts Inst. of Tech., Cambridge). J. Org. Chem., 29: 2799-2800(Sept. 1964).

A two-step method was used to prepare oxetane-d_6. 1,3-propane-d_6-diol was treated with acetyl bromide to form γ-bromopropyl-d_6 acetate, which was then converted to oxetane-d_6 with strong base. Complete separation of the olefin from the less volatile cyclic ether was accomplished by repeated low-temperature trap-to-trap distillations. The isotopic purity of the final product was 98.8%. (M.C.G.)

39270 A METHOD OF LABELLING ORGANIC COMPOUNDS WITH H^3 BY UTILIZING THE WILZBACH TECHNIQUE. G.-J. Uhlenhut and H. Koch (Institut für Angewandte Radioaktivität, Leipzig). Kernenergie, 7: 504-6(June-July 1964). (In German)

An apparatus is described for use in the production of labeled organic compounds employing the gas exposure technique. Comparative studies showed that by using uv irradiation or Tesla discharges the specific activity obtained is 5 to 500 times higher than that achieved by the original Wilzbach technique of labeling. On the basis of these results optimum operating conditions could be established. (auth)

39271 STUDY ON THE FORMATION OF COMPLEXES BETWEEN URANYL ION AND SOME AMINO ACIDS. G. Porcelli and A. Gaudiano (Laboratori di Biologia, Istituto Superiore di Sanità, Rome). Rend. Ist. Super. Sanita, 24: 291-8(1961). (In Italian)

The complexes of three amino acids with UO_2^{++} were studied. Spectrophotometric measurements showed that the amino acids had a hyperchromic and slightly bathochromic effect on the absorption of $UO_2(NO_3)_2$ at constant pH (1.50). For simplicity studies were restricted to two monoaminomonocarboxylic acids (glycine, alanine) and an imino acid (proline), using potentiometric pH measurements. The pH must be maintained below 3.5 to prevent hydrolysis of UO_2^{++}. The degree of complexation between ligand and ion in this region is predominantly 1. Potentiometric titration curves are graphed, and the pK of instability (pL for $\bar{n} = 0.5$) is determined graphically, using the methods of Bjerrum and of Schwarzenbach. The relative instability constants at 25°C and the corresponding pK's are: glycine, 7.9×10^{-11} ($pK\ 10.1_9$); alanine, 7.2×10^{-11} ($pK\ 10.1_4$); and proline, 1.7×10^{-11} ($pK\ 10.7_3$). (BBB)

39272 USE OF THE EXCITATION SPECTRUM TO DETERMINE THE DEGREE OF DISSOCIATION OF FLUORESCENT METAL CHELATES. Robert J. Argauer and

Charles E. White (Univ. of Maryland, College Park). Spectrochim. Acta, 20: 1323-6(Sept. 1964).

The relationship between the absorption spectrum and the excitation spectrum of the zirconium–flavonol chelate was used to calculate the degree of dissociation of the complex. For the 1:1 ratio a 23% dissociation in a 30% ethanol solution was found. The method was also applied to the thorium–morin chelate. Values obtained agree well with the spectrophotometric method for obtaining dissociation constants. (auth)

Radiation Chemistry and Radiochemistry

Refer also to abstract 38806.

39273 (AD-417474) RADIATION-COLORING OF ALKALI HALIDE CRYSTALS CONTAINING SULFATE IONS. ONR Technical Report No. 5. Allen B. Scott and B. J. Bosco (Oregon State Univ., Corvallis). Aug. 1, 1963. Contract Nonr-1286(05). 7p.

A third effect which may be anticipated in view of the interactions between divalent anions and divalent cations in an alkali halide matrix is discussed. Alkali halide crystals containing Ca or Sr additions may be colored much more rapidly and to a higher initial color–center concentration, by x-irradiation than relatively pure crystals. Whether the effect is due to the presence of positive-ion vacancies or to the specific properties of the divalent cations themselves is not yet ascertained, but it was supposed that sulfate ions, acting both to repress the positive–ion vacancy concentration and to form ion–pairs (of even a precipitated second phase of $CaSO_4$ or $SrSO_4$) should counteract the accelerating effect of the divalent cations. (auth)

39274 (AE-149) AN ANION-EXCHANGE METHOD FOR THE SEPARATION OF P-32 ACTIVITY IN NEUTRON-IRRADIATED BIOLOGICAL MATERIAL. K. Samsahl (Aktiebolaget Atomenergi, Stockholm). June 1964. 11p. (UDC-541-183-123-3-577-3)

Strong hydrochloric acid solutions containing small amounts of orthophosphoric and citric acid and radioactive tracers of the elements Na, P, K, Ca, Sc, Cr, Mn, Ni, Rb, Sr, Cs, Ba, La, and Ce were titrated with a water suspension of strongly basic anion-exchange resin in the hydroxide form. The titration was carried out to pH = 3.0. It was followed by filtration of the mixture on the top of a small anion-exchange column in the chloride form and a final washing with water. Phosphorus was quantitatively absorbed by the resin and the scandium retention was better than 96 per cent. The remaining elements passed quantitatively into the effluent, with the exception of nickel, which was adsorbed to a very small extent. (auth)

39275 (BKI-5) THE EFFECT OF pH ON PRIMARY RADICAL AND MOLECULAR YIELDS IN THE GAMMA RADIOLYSIS OF AQUEOUS SYSTEMS. Oxalic Acid–Oxygen Solutions, pH 1.6–13. Z. Draganić, I. Draganić, and M. Kosanić (Institut za Nuklearne Nauke "Boris Kidrič," Belgrade). Apr. 1963. 27p.

Radiation yields of CO_2, H_2, and H_2O_2 formed were measured at 0.05 M oxalic acid concentration at pH 1.6 to 13. Up to a pH ≤ 7, the results are quantitatively consistent with a simple scheme which allows the determination of the primary yields in gamma radiolysis of water by using the following relations: $G_H = G(H_2O_2) - G(H_2)$; $G_{OH} = {}^1\!/_2 G(CO_2)$; $G_{H_2} = G(H_2)$; $G_{H_2O_2} = {}^1\!/_2\{G(H_2O_2) + G(H_2) - {}^1\!/_2 G(CO_2)\}$. The facts which should be taken in account to explain the results measured at pH > 7 are discussed. The basic form of the OH radicals seems evident. (auth)

39276 (BNL-8188) Co^{60} GAMMA-RADIATION-INDUCED COPOLYMERIZATION OF ETHYLENE AND CARBON MONOXIDE. P. Colombo, L. E. Kukacka, J. Fontana, R. N. Chapman, and M. Steinberg (Brookhaven National Lab., Upton, N. Y.). [1963]. Contract AT-30-2-GEN-16. 13p. (CONF-571-9)

From American Chemical Society 148th National Meeting, Chicago, Aug.-Sept. 1964.

A study was made of the radioinduced copolymerization of the ethylene–CO system and of the properties of the resulting copolymers. The kinetics of the copolymerization was studied over a wide range of conditions. The copolymer properties studied included crystallinity, infrared spectra, density, melting point, thermal decomposition, etc. (D.L.C.)

39277 (BNL-8264) PRELIMINARY COST ESTIMATE FOR Co^{60} GAMMA RADIATION POLYMERIZATION OF ETHYLENE. M. Steinberg and B. Manowitz (Brookhaven National Lab., Upton, N. Y.). July 1964. Contract [AT(30-2)-Gen-16]. 12p.

The economics of a plant for the radioinduced polymerization of ethylene is studied on the basis of certain assumptions regarding the rate dependence on pressure and radiation intensity, G value, gamma energy deposition efficiency, etc. For a pressure of 1000 atm and a temperature of 20°C, a minimum production or mill cost is estimated to be ~$0.01/lb polyethylene for an intensity of 1 to 4×10^6 rad/hr (1 to 2 MC ^{60}Co). Other process and product advantages are discussed. Further economic and process improvements may result in a lowering of the cost to $0.002/lb polyethylene. (D.L.C.)

39278 (EUR-1643.3(p.265-74)) STUDY OF SOME LUMINESCENT EMISSIONS OF X-IRRADIATED ALKALI HALIDES. M. Boni and P. Camagni (European Atomic Energy Community. Joint Nuclear Research Center, Ispra, Italy).

The behavior of uv radioluminescent bands in x-irradiated KCl and KBr, pretreated in gaseous media at high temperature, is described. It appears to be connected with an impurity-nucleated hole-center. (auth)

39279 (EUR-1643.e(p.347-64)) THE EURATOM TRANSPLUTONIUM PROGRAMME. J. Kooi (European Atomic Energy Community. Transuranium Inst., Karlsruhe, Germany).

Euratom's activities in the field of the production of and research into transplutonium elements are described, and recent results presented. (auth)

39280 (HW-81964) BETA-GAMMA DOSE RATES FROM U^{232} IN U^{233}. F. E. Owen (General Electric Co., Hanford Atomic Products Operation, Richland, Wash.). Apr. 1964. Contract AT(45-1)-1350. 25p.

Dose rates from ^{233}U samples containing ^{232}U as impurity are predicted for betas and gammas from daughters of 74-year ^{232}U. (R.E.U.)

39281 (NIJS-R-417) POLYMOLECULARITY OF IRRADIATION-POLYMERIZED VINYLCHLORIDE. N. Vene (Nuklearni Institut "Josef Stefan," Ljubljana, Yugoslavia). Sept. 1963. 3p.

The polymolecularity (distribution of molecular weights) is proportional to $(dB/dx)_0$, the infinite-dilution extrapolated derivative of the width of a sedimentation

curve. $(dB/dx)_0$ was determined in ultracentrifuge runs for several polyvinyl chloride samples produced by gamma irradiation under different conditions. The results show that polymolecularity increases with conversion and irradiation dose. (D.L.C.)

39282 (ONR-16(Vol.1)(p.149-57)) APPLICATIONS OF RADIOCHEMISTRY TO SOLUTION OF RADIOLOGICAL PROBLEMS. N. E. Ballou (Naval Radiological Defense Lab., San Francisco).

The application of radiochemistry to the definition of properties of nuclear weapons debris has been described. Properties selected as of importance to radiological effects include dose rates, radionuclide composition (fission product and neutron induced radionuclides), fractionation, and physical and chemical states (solubilities and oxidation states). In addition, the radiochemical method for determination of fission weapon yields has been outlined. (auth)

39283 (AEC-tr-6390(p.441-50)) METHODS OF MODERN RADIOCHEMISTRY AND REGIONS OF ITS APPLICATION. A. K. Lavrukhina. Translated from Tr. Tashkentsk. Konf. po Mirnomu Ispol'z. At. Energii, Akad. Nauk Uz. SSR, 2: 334-?(1960).

Radiochemical studies of nuclear transformations of Cu, Hf, and U under the action of 660-Mev protons are reported. These served as a theoretical basis for investigations of nuclear reactions that take place in the earth's crust, meteorites, and other natural objects and which lead to a change in the isotopic composition of the elements. Radiochemical studies of artificial elements such as francium are described. Methods of determining small amounts of impurities by activation analysis are discussed. (M.C.G.)

39284 (AEC-tr-6390(p.466-74)) STATE OF MICROQUANTITIES OF RADIOELEMENTS IN SOLUTIONS. N. I. Ampelogova. Translated from Tr. Tashkentsk. Konf. po Mirnomu Ispol'z. At. Energii, Akad. Nauk Uz. SSR, 2: 353-?(1960).

Methods are described for studying the ionic, colliodal, and molecular states of radioelements in solution. The method of adsorption on non-ion-exchange surfaces, extraction by organic solvents, and sorption by ion exchange resins in conjunction with ultrafiltration and electrochemical isolation, make it possible to establish the presence of molecular and complex forms, to determine the values of their charge, and to elucidate their composition. As an example of the use of some of these methods, studies of the state of polonium are described. In a study of the state of a whole series of radioelements, it was found that they form both true colloids and pseudocolloids. The type of colloid obtained depended on the solution pH, composition and degree of contamination of the solution, and the concentration and nature of the radioelement. (M.C.G.)

39285 (AEC-tr-6390(p.475-9)) DETERMINATION OF THE CHARGE OF COMPLEX IONS OF RADIOELEMENTS BY THE EXCHANGE METHOD. A. M. Trofimov and A. N. Stepanova. Translated from Tr. Tashkentsk. Konf. po Mirnomu Ispol'z. At. Energii, Akad. Nauk Uz. SSR, 2: 360-?(1960).

A method is described for determining the charge of complex ions formed by radioisotopes in solutions. The distribution coefficients of the ions on two ion exchange resins under exactly the same conditions were determined, along with the specific volumes of the ion exchange resins in the swollen state under the same conditions. Charges of polynuclear complex ions of ruthenium were determined to be 6+. The variation of the charges of radiozirconium ions in nitric acid solution as a function of acid concentration was also determined. (M.C.G.)

39286 (AEC-tr-6390(p.493-8)) CHARACTERISTICS OF THE IDENTIFICATION AND ANALYSIS OF LABELLED ORGANIC COMPOUNDS. I. N. Bukharov. Translated from Tr. Tashkentsk. Konf. po Mirnomu Ispol'z. At. Energii, Akad. Nauk Uz. SSR, 2: 372-?(1960).

The basic principles and characteristics of the identification and chemical analysis of labeled organic compounds are discussed. A scheme for analyzing the compounds is recommended; it includes: description of external appearance, solubility, qualitative tests for elements, purity check, microanalysis, qualitative color reactions, determination of equivalent weight, production of derivatives, development of micromethods, and study of stability of labeled compound during storage. (M.C.G.)

39287 (AEC-tr-6390(p.499-505)) SPECTRAL ANALYSIS IN THE PRODUCTION OF RADIOACTIVE PREPARATIONS. V. S. Grinev, V. A. Gromov, and I. A. Korovina. Translated from Tr. Tashkentsk. Konf. po Mirnomu Ispol'z. At. Energii, Akad. Nauk Uz. SSR, 2: 377-?(1960).

The use of spectral analysis in production of radioactive compounds is discussed. Spectral analysis makes possible the unambiguous identification of labeled organic compounds and can thus be used for quality control in industrial production. The method of emission semiquantitative analysis for impurities and methods of adsorption spectral analysis in the visible and ultraviolet region are described. (M.C.G.)

39288 (AEC-tr-6390(p.516-24)) THE ANALYSIS OF THE RADIATIONS OF RADIOACTIVE PREPARATIONS. K. N. Shlyagin. Translated from Tr. Tashkentsk. Konf. po Mirnomu Ispol'z. At. Energii, Akad. Nauk Uz. SSR, 2: 389-?(1960).

Analyses to determine the spectral composition of radiations from radioactively labeled compounds, to determine the relative and absolute activity of the isotopes contained in the preparation, and to identify the radioisotopes are discussed. The apparatuses include differential chambers, G-M counters, magnetic beta spectrometers, scintillation spectrometers, and proportional counters. (M.C.G.)

39289 (AEC-tr-6390(p.571-3)) DOUBLE BONDS IN POLYETHYLENE IRRADIATED BY FAST ELECTRONS. N. A. Slovokhotova, A. T. Koritskiĭ, and N. Ya. Buben. Translated from Tr. Tashkentsk. Konf. po Mirnomu Ispol'z. At. Energii, Akad. Nauk Uz. SSR, 2: 430-?(1960).

The method of infrared spectroscopy was used to investigate the formation of double bonds in polyethylene during its irradiation by fast electrons in the temperature range form −196 to +50°C in nitrogen medium. The appearance of vinyl unsaturation in the irradiation of high-pressure polyethylene is explained by the end effect or by cleavage of the principle chain of the polymer. The decrease in vinyl unsaturation in irradiation of low-pressure polyethylene was apparently due to interaction of the vinyl groups with the radicals formed during irradiation. (M.C.G.)

39290 (AEC-tr-6390(p.574-85)) INVESTIGATION OF FREE RADICAL REACTIONS IN IRRADIATED TEFLON. Yu. D. Tsvetkov, Ya. S. Lebedev, and V. V. Voevodskiĭ.

Translated from Tr. Tashkentsk. Konf. po Mirnomu Ispol'z. At. Energii, Akad. Nauk Uz. SSR, 2: 431-?(1960).

Electron paramagnetic resonance (EPR) was used to study the mechanism of radiolysis and free radical reactions in irradiated teflon. The spectra of fluoroalkyl radicals and temperature dependence of the line width were determined. The diffusion of O_2, H_2, and NO in irradiated teflon and reactions with the free radicals present were studied. (M.C.G.)

39291 THE SZILARD-CHALMERS PROCESS IN CRYSTALS. III. THE EFFECT OF THE CHEMICAL CONSTITUTION. 1. THE RETENTION DEPENDENCY OF THE NATURE OF THE ANION AND BONDING IN COBALT AMINES. T. Costea and I. Dema. Acad. Rep. Populare Romine, Studii Cercetari Fiz., 14: 571-81(1963). (In Rumanian)

One of the most suitable complex compounds for investigating the Szilard-Chalmers recoil reaction is $[Co(NH_3)_6](NO_3)_3$ because it undergoes a clear monoisotopic transformation, $[^{59}Co(n,\gamma)^{60}Co]$. The resulting ^{60}Co can be detected from its powerful γ-emission. Co-amines have been studied extensively. Forty Co-amine complexes with F_3, Cl_3, $(SCN)_3$, Br_3, I_3, $(ClO_4)_3$, $(MnO_4)_3$, etc., were prepared according to the standard methods and irradiated in the reactor with 6×10^{11} and 2×10^{11} n/cm^2/sec for 40 hr. After irradiation, the ejected ^{60}Co was separated, and the activities of both the ejected and the retained ^{60}Co atoms were determined with an end-window counter. From these activities, the retention values, in per cents of the original bound Co, were calculated. The lowest retention (1.5%) was for $[Co(HN_3)_6]_2(B_4O_7)_3$, while the highest (90%) was for $[Co(NH_3)_6](CH_3COO)_3$. The high degree of dependence of ^{60}Co retention on the chemical nature of the complexes was explained by the various tendencies towards recombination with the recoil atom depending on the chemical structure and the crystal lattice configuration. (OID)

39292 A METHOD FOR THE SYNTHESIS OF LABELED RIBONUCLEOTIDES. U. Z. Littauer, Y. Kimhi, and M. Avron (Weizmann Inst. of Science, Rehovoth, Israel). Anal. Biochem., 9: 85-93(Sept. 1964).

A method is described for the preparation of adenosine, uridine, cytidine, and guanosine di- and triphosphates, labeled with ^{32}P in the α, β, or γ position. For the synthesis of nucleoside di- and triphosphates labeled with ^{32}P in the α-position, the method involves preparing ^{32}P-labeled RNA, phosphorolyzing it with polynucleotide phosphorylase to nucleoside diphosphates, which can further be converted to the nucleoside triphosphates via photophosphorylation with swiss-chard chloroplasts. ^{14}C-Labeled nucleosides were also synthesized by this method starting with ^{14}C-labeled RNA. β-^{32}P-Nucleoside triphosphates were synthesized by exchanging ^{32}P inorganic phosphate with the terminal phosphate of unlabeled nucleoside diphosphates by the aid of polynucleotide phosphorylase. The diphosphates can be converted to nucleoside triphosphates by photophosphorylation with swiss-chard chloroplasts. γ-^{32}P-Nucleoside triphosphates were in turn prepared by photophosphorylation of unlabeled diphosphates with a chloroplast suspension containing ^{32}P-orthophosphate. (auth)

39293 RADIOCHEMICAL PROCESSES IN RADIOLYSIS OF PERFLUOROCARBONS. V. A. Khramchenkov. At. Energ. (USSR), 17: 53-6(July 1964). (In Russian)

Schemes of radiation-chemistry processes in perfluorodienes were proposed on the basis of analysis of the condensed phase of irradiated waxy perfluorohexadecadiene and liquid perfluorododecadiene and of these combined gas phases separated during irradiation. The predominance of the radiation chemistry processes of destruction in the hard phase was shown experimentally. The possibility of separating molecular fluorine by radiolysis of fluorocarbons was demonstrated. (tr-auth)

39294 EFFECTS OF IRRADIATION ON THE STABILITY OF PLASTIC MASS SCINTILLATORS. V. D. Bezuglyi and L. L. Nagornyi. At. Energ. (USSR), 17: 67-70(July 1964). (In Russian)

Effects of gamma radiation on the stability of plastic scintillators composed of a polymer plus a luminophor were studied to determine the mechanism of plastic scintillator failure. Tables are given of light emission for PBP, PPP, PPO, BPO, 1,3,5-triphenylpyrazoline, p-terphenyl plus POPOP, PBE, BBE, BBO, polystyrene, polyvinyltoluene, and polyvinylxylene, and various combinations of these compounds irradiated by doses of 4×10^5 to 8×10^6 rad in vacuum and in air. Absorption coefficients and spectra were determined. (M.J.T.)

39295 SCINTILLATIONS IN MELTS. H. Schneider and K. Woelcken (Justus Liebig-Universitat, Giessen, Ger.). Atomkernenergie, 9: 293-6(July-Aug. 1964). (In German)

Scintillations in molten naphthalene and in 1-methylnaphthalene under the irradiation of γ quanta (1.17 and 1.33 Mev), electrons (625 kev) and α particles (5.28 Mev) were measured. Anthracene, POPOP, and PBD in various concentrations were used as activators. The behavior of the substances was found to be comparable to that of ordinary liquid scintillators. The absolute efficiencies were lower. (auth)

39296 SYNTHESIS OF ^3H-ENDOXAN WITH HIGH SPECIFIC ACTIVITY. B. Steiner, H. Arnold, E. H. Graul, H. Bekel, H. Hundeshagen, and W. Wilmanns (Phillips-Universität, Marburg, Ger. and Asta-Werke AG, Brackwede, Ger.). Atompraxis, 10: 358-61(Aug. 1964). (In German)

High specific activity ^3H-Endoxan was synthesized by three different procedures. The catalytic exchange reaction based on bis (-β-chlorethyl-) amino hydrochloride resulted in a very slight specific labeling of at most 2%. Synthesis of ^3H-Endoxan based on calcium carbide and tritiated water via the acetylene, ethylene, and ethylene-oxide stages produced a yield of ca 10% in the active group. The best yield was produced by synthesis via ethylene-^3H, which was obtained from dibromoethane-^3H. The decrease in the chemical and radiochemical yield during the synthesis procedure can be explained by the non-quantitative course of the ethylene/hypochloric acid reaction. A further decrease was found in the last stages of synthesis, i.e. those preceding the final product. The chemical yields in the individual stages were determined by gas volumetry, and the activities of the substances available in solid or liquid form were measured in a liquid scintillation spectrometer. Because of the structure of the Endoxan molecule, it must be assumed that part of the tritium belonging to the CH_2 group adjacent to the nitrogen is exchanged. (auth)

39297 QUENCHING OF SCINTILLATING SOLUTIONS BY ALIPHATIC ALCOHOLS. Pierre Lerch and Maurice Cosandey (Hospital Cantonal Universitaire, Lausanne, Switzerland). Biophysik, 2: 67-72(1964). (In French)

The quenching effect of different alcohols on the pulse height and on the resolution of liquid scintillators was studied. The reciprocal of pulse height and the resolution squared have been found to vary linearily with alcohol concentration. It was found that the molecular quenching constant for normal alcohols slightly increases with chain

length. The same behavior was established for secondary and tertiary alcohols, which are nevertheless slightly weaker quenching agents. (auth)

39298 HOW RADIATION AFFECTS POLYPROPYLENE. Can. Chem. Process., 48: 63-6(Aug. 1964).

High-energy radiations can initiate free radical reactions in polypropylene resulting in crosslinking degradation grafting or other chemical modifications. When a photon is absorbed the excitation energy is localized on a carbon atom and causes rupture of a covalent band. The free radical left may undergo various reactions. Changes in mechanical and electric properties are summarized and grafts copolymerization with other organics are discussed. Experience with radiations up to 50 megarads is described. (C.E.S.)

39299 THE RADIATION CHEMISTRY OF AQUEOUS SOLUTIONS OF CHLORAL HYDRATE AND OF BROMAL HYDRATE. R. G. McIntosh, R. L. Eager, and J. W. T. Spinks (Univ. of Saskatchewan, Saskatoon). Can. J. Chem., 42: 2033-41(Sept. 1964).

The radiation chemistry of aqueous solutions of chloral hydrate and of bromal hydrate was investigated. The electric conductivity method of Andrews and Shore was used to follow the appearance of acid. The yield of acid was found to be dependent on the dose rate, contrary to the conclusion reached by Andrews and Shore but in agreement with the results of others. A reexamination of Andrews and Shore's paper indicates that an incorrect interpretation was made of their data and reveals that, in fact, their data also indicate a dose rate dependence for the yield of acid. A free radical mechanism is proposed which is in good agreement with the observed dependence of the rate of formation of acid upon the dose rate and upon the solute concentration in both the presence and in the absence of oxygen. (auth)

39300 PRIMARY PROCESS STUDIES BY MONOISOTOPIC PHOTOSENSITIZATION OF THE REACTIONS OF Hg $6(^3P_1)$ ATOMS WITH ALKYL CHLORIDES. J. K. S. Wan, O. P. Strausz, W. F. Allen, and H. E. Gunning (Univ. of Alberta, Edmonton, Can.). Can. J. Chem., 42: 2056-64 (Sept. 1964).

The specific nature of the primary process in the reaction of ^{202}Hg $6(^3P_1)$ atoms, photoexcited in natural mercury vapor by a cool ^{202}Hg electrodeless discharge source, with CH_3Cl was examined in detail. Primary C—Cl bond scission occurs with unit efficiency. Quantum yields (φ) for the two primary modes of decomposition, $^{202}Hg + Cl + CH_3 \xleftarrow{b} [CH_3Cl + {}^{202}Hg^*] \xrightarrow{a} {}^{202}HgCl + CH_3$, were found to have values of 0.71 (b) and 0.29 (a). The effect of various reaction parameters on ^{202}Hg enrichment in the calomel product was investigated and the importance of isotopic mercury depletion in the reaction zone demonstrated by the use of intermittent illumination. A study of the reaction of ethyl, n-propyl, i-propyl, t-butyl, and n-amyl chlorides revealed a relation between the molecular structure of the alkyl chloride and the efficiency of the monoisotopic route (a) to calomel formation. Thus, while the reactions of all the normal alkyl chlorides have φ_a values between 0.29 and 0.32, φ_a (isopropyl chloride) is only 0.22 and φ_a (t-butyl chloride) is 0.17. (auth)

39301 THE DECOMPOSITION OF RADIOACTIVE ACETATE IN SOILS. I. L. Stevenson and K. C. Ivarson (Dept. of Agriculture, Ottawa). Can. J. Microbiol., 10: 139-42(Apr. 1964).

Combined manometric and radioactive techniques were used to determine oxygen uptake and $^{14}CO_2$ evolution during the oxidation of ^{14}C-acetate in soil. It was found that a large percentage of $^{14}CO_2$ remained in the soil causing anomalous respiratory quotients during the first hours of respiration. Acidification of the soil to pH 5.0 released this residual $^{14}CO_2$ with the result that the total $^{14}CO_2$ collected after the acid treatment compared favorably with the corresponding oxygen uptake. Recovery of $^{14}CO_2$ during the 6 hour exposure of soil to ^{14}C-acetate indicated that only 30% of the substrate was completely oxidized. The remainder of the acetate is assimilated into microbial tissue to be deposited eventually in the soil organic fraction. (auth)

39302 EFFECT OF SUBSTITUTED AROMATIC COMPOUNDS ON THE RADIOLYSIS OF CYCLOHEXANE. W. V. Sherman (Army Natick Labs., Natick, Mass.). Chem. Ind. (London), No. 28, 1266-7(July 11, 1964).

A study of the substituent effect in the radiolysis of liquid cyclohexane containing substituted benzenes was undertaken. A table, giving G values, shows the effect of the following aromatic solutes on the yields of cyclohexene and bicyclohexyl in the γ radiolysis of cyclohexane: benzene, pyridine, naphthalene, biphenyl, toluene, nitrobenzene, chlorobenzene, bromobenzene, benzonitrile, phenol, aniline, phenyl mercaptan, and benzophenone. The results showed that all the substituted benzenes studied, except chlorobenzene, decrease the yields of both cyclohexene and bicyclohexyl. The behavior of chlorobenzene is exceptional in that while it has a marked effect on the yield of cyclohexane the yield of bicyclohexyl is essentially unaffected by its presence. The majority of the solutes increase the ratio G (cyclohexene)/G(bicyclohexyl), i.e. the cyclohexene yield is less sensitive than the bicyclohexyl yield to the presence of the aromatic solute. At room temperature, dimerization of cyclohexyl radicals is slower than disproportionation and therefore more sensitive to a radical-scavenging solute. Hence, a solute that behaves as a radical scavenger might be expected to increase this ratio. In the case of benzene, chlorobenzene, and bromobenzene the ratio is decreased below that for pure cyclohexane, which indicates that the action of these three solutes is not primarily scavenging of cyclohexyl radicals. Furthermore, the fact that the relative ability of these solutes to protect cyclohexane does not correspond to their relative reactivity towards alkyl radicals (as measured by their methyl affinities) rules out the possibility that the phenomena are due mainly to scavenging of cyclohexyl radicals. It was concluded that the observed effect of aromatic compounds in the radiolysis of cyclohexane cannot be attributed solely to processes involving radical scavenging, ionization transfer, or electron capture. (BBB)

39303 SORPTION OF RADIOISOTOPES ON PRECIPITATES. XII. ELUTION OF FISSION PRODUCTS FROM MANGANESE(IV) HYDROXIDE PRISMS. Z. Kolarík and J. Krtil (Inst. of Nuclear Research, Czechoslovak Academy of Sciences, Řež). Collection Czech. Chem. Commun., 29: 1604-11(July 1964). (In German)

The possibility of separating long-lived fission products by elution from $Mn(OH)_4$ prisms was studied. The conditions for the separation of trace amounts of ^{137}Cs, ^{90}Sr, ^{90}Y, ^{144}Ce, ^{152}Eu, ^{154}Eu, $^{106}RuNO$, and ^{95}Zr by elution with solutions of HNO_3, H_2SO_4, and HCl and by NH_4Cl were found. (tr-auth)

39304 CHEMICAL TRANSFORMATIONS ACCOMPANYING DECAY OF RADIUM D(^{210}Pb). Madeleine Adloff and Jean-Pierre Adloff (Centre de Recherches Nucleaires, Strasbourg). Compt. Rend., 259: 141-3(July 6, 1964). (In French)

The distribution of the chemical forms of RaE formed by decay of RaD in molecules of tetraphenyl lead and tetraphenyl lead chloride was determined by paper chromatography. (tr-auth)

39305 THE EFFECT OF ELECTROLYTES ON THE ABSORPTION OF DYES BY RADIOACTIVE PRECIPITATES OF $BaSO_4$. Vict. I. Spitsyn and V. V. Gromov (Inst. of Physical Chemistry, Academy of Science, USSR). Dokl. Akad. Nauk SSSR, 156: 427-9(May 11, 1964). (In Russian)

The sorption of acid orange and methyl blue by $^{35}BaSO_4$ precipitates was studied as a function of the concentration of added NaCl, $NaNO_3$, and $Mg(NO_3)_2$. In the absence of interfering ions, absorption of acid orange increases with increased ^{35}S in the $^{35}BaSO_4$; with an increased Na^+, Cl^- and NO_3^-, sorption by radioactive and nonradioactive $^{35}BaSO_4$ is identical. The weakened capacity of $^{35}BaSO_4$ in the presence of electrolytes is a result by a changed in the ionic strength in the solution, ion competition, reduced surface charge due to increased electric conductivity, and salting out of the dye. (R.V.J.)

39306 THE MECHANISM OF POLYISOBUTYLENE RADIOLYSIS. E. N. Teleshov, A. N. Pravednikov, and S. S. Medvedev. Dokl. Akad. Nauk SSSR, 156: 1395-8 (June 21, 1964). (In Russian)

Purified samples of PIB were irradiated in vacuum with ^{60}Co γ rays or with 1.6 Mev electrons at temperatures of -60, -75, -110, -140, and -180°C. The concentration of radicals according to the EPR spectrum was found to be proportional to the irradiation dose at temperatures below the solidification temperature (~ -65°C). The G yield was 0.8 to 1.5 radicals per 100 ev. The destruction of radicals is rapid on irradiating PIB as a liquid. Radical I, $C(CH_3)_2 - C^*H - C(CH_3)_2$, is formed by removal of a hydrogen atom from the polymeric molecule. Other radicals are formed by disruption of the main polymeric chain, and these radicals can disproportionate even at -196°C to form a vinylidene type of double bond. The radiolysis of PIB is accompanied by the formation of isobutylene, whose yield increases significantly only on increasing the temperature to room temperature. The isobutylene radical was detected in the EPR spectrum, and may be responsible for the movement of methyl radicals observed in irradiated PIB samples. (TTT)

39307 RADIOLYSIS OF TETRACHLOROETHYLENE AND HEXACHLOROBUTADIENE. L. M. Kogan, N. S. Rabovskaya, and S. I. Volfkovich (Moscow State Univ. and All-Union Scientific Research Inst. for Chemical Protection of Plants, USSR). Dokl. Akad. Nauk SSSR, 157: 127-30(July 1, 1964). (In Russian)

Samples of C_2Cl_4 and C_4Cl_6 (20 ml) were subjected to ^{60}Co γ-doses varying from 0.5×10^{22} to 1.4×10^{23} ev/ml. The irradiated samples were analyzed for molecular chlorine (iodometrically), specific gravity, refractive index and relative viscosity. It was found that specific gravity, refractive index, and relative viscosity increased with increasing γ dose. Unreacted material was distilled off, and the residue was analyzed by fractional distillation. On analyzing irradiated tetrachloroethylene, the reaction products were found to be hexachloroethane, hexachlorobutadiene, octachlorobutene, hexachloro-4-dichloromethylene-cyclopentene, and a red oil having the composition C_8Cl_{10} (78.6% Cl and a mol wt of 451). The principal products formed during the irradiation of hexachlorobutadiene were hexachloroethane, a red oil with the composition C_8Cl_{10}, and a dark-brown residue that would not distill. The radiation yields of both compounds decrease with increasing irradiation dose. The yields of reaction products from C_2Cl_4 are 3 to 5 times higher than the yields from irradiated C_4Cl_6. The value of G_{max} for C_2Cl_4 is 8.8 molecules/100 ev at a dose of 0.5×10^{22} ev/ml, while the value of G_{max} for C_4Cl_6 at this same dose is only 2.8 molecules/100 ev. The content of hexachloroethane increased with increasing dose, and indicates the radiation stability of this compound. (TTT)

39308 THE NATURE OF ACTIVE CENTERS IN THE REACTION INVOLVING THE ISOTOPIC EXCHANGE OF HYDROGEN ON γ-RAYED SILICA GEL. G. K. Boreskov, V. B. Kazanskii, Yu. A. Mishchenko, and G. B. Pariskii (Inst. of Chemical Physics, Academy of Sciences, USSR and Inst. of Catalysis, Academy of Sciences, Siberian SSR). Dokl. Akad. Nauk SSSR, 157: 384-7(July 11, 1964). (In Russian)

Samples of silica gel were outgassed at 400, 500, and 600°C, and then subjected to ^{60}Co γ rays at liquid nitrogen or at room temperature. The irradiation dose was varied from 2×10^5 to 2×10^7 R. The catalytic activity of the silica gel in promoting the $H_2 - D_2$ exchange reaction was measured on an equimolecular mixture at 77°K from the thermal conductivity of the $H_2 - D_2$ mixture. At the same irradiation dose, the catalytic activity of the silica gel increases with increasing aluminum content in the silica gel. The purest silica gel was the least active. The specific catalytic activity increased with increasing duration of the outgassing treatment, and with increasing irradiation dose. The catalytic activity is lost on heating the irradiated sample in hydrogen. Thus, it was concluded that the hydrogen adsorption and the catalytic isotopic exchange reaction take place on the same surface defects formed by the irradiation. An EPR spectrum analysis showed that the surface defects were associated with an aluminum impurity in the irradiated silica gel. (TTT)

39309 FORMATION OF EXCITED ETHYL RADICALS WHEN HOT HYDROGEN ATOMS REACT WITH ETHYLENE. B. G. Dzantiev, A. P. Shvedchikov, and B. V. Borshagovskii (Inst. of Chemical Physics, Academy of Sciences, USSR). Dokl. Akad. Nauk SSSR, 157: 653-5 (July 21, 1964). (In Russian)

In studying the reaction of hot tritium atoms with ethylene and during radiolysis of mixtures containing ethylene in a nuclear reactor, an abnormally high ratio of ethane to butane was observed that does not agree with the accepted reaction schemes for ethyl radicals. These results can be explained by noting that the reactivity of the ethyl radicals, which are formed by reacting atomic hydrogen with ethylene, depends on the energy of the H atoms. Photolysis of a mixture of hydrogen iodide and ethylene was carried out with a mercury vapor lamp under softer conditions in order to obtain a clear interpretation of the experimental data. The products were analyzed by gas chromatography, infrared spectrometry, and manometrically. It is calculated that H atoms having kinetic energies of 0.8 and 1.8 ev are formed by radiolysis of HI. Some of the H atoms react with ethylene as follows: $H^* + C_2H_4 \rightarrow C_2H_5^*$. The excited ethyl radicals $C_2H_5^*$ have an energy $E^* = q + E(H)$, where $q = 38$ kcal/mol is the heat of reaction of a H atom with ethylene. The yield of ethane does not depend on the temperature from 0 to 250°C, or on the addition of large amounts of argon (80%) to the system. However, the ethane yield drops sharply on adding helium to the system. The helium atoms decrease the average energy of the hot H atoms which react to form less reactive ethyl radicals. These ideas are useful in the interpretation of

experimental data on the radiolysis of organic substances. (TTT)

39310 RADIOLYTIC PROPERTIES OF AMINO ACIDS AND PEPTIDES. V. A. Sharpatyi, K. G. Ianova, A. V. Tuichiev, A. P. Ibragimov (Karpov Inst. of Physics and Chemistry, [Moscow]). Dokl. Akad. Nauk SSSR, 157: 660-3(July 21, 1964). (In Russian)

A total of 26 amino acids and 10 peptides were irradiated as solids at −196°C and at room temperature. The EPR spectra of each irradiated compound are described at −196°C and after heating the sample to 25°C. The G yield for the formation of radicals (G_R) is given for these irradiated compounds. The α-amino acids can be divided into three groups according to radiation stability: the aliphatic amino acids not having a heteroatom have a G_R value of about one, the aromatic amino acids have a G_R value of ~0.3 and lower, and aliphatic amino acids including various functional groups with heteroatoms of O, S, or N have a value of $1 > G_R > 0.3$. An aromatic ring confers radiation stability on a compound. Only the sulfur-containing amino acids such as methionine and cysteine give spectra indicating the presence of functional groups (-S-H, -S-S-, and -S-CH_3). The other amino acids do not give EPR spectra indicative of the functional group. On irradiating globulin from cotton and the simplest peptides, a difference in EPR spectra and in radical yield G_R is observed as compared to irradiation of the corresponding simple amino acid. The lower radical yield in the dipeptides of α-alanine and β-alanine as compared to the G_R values in the corresponding amino acids (a factor of 2 to 3 higher) indicates that the peptide bond confers radiation stability on the compound. The EPR spectra of the irradiated dipeptides also differ significantly from the EPR spectra of the corresponding amino acids. (TTT)

39311 THE NATURE OF THE REDUCING RADICAL PRODUCED BY IRRADIATION OF WATER AND AQUEOUS SOLUTIONS. V. N. Shubin (Inst. of Electrochemistry, Academy of Sciences, USSR). Dokl. Akad. Nauk SSSR, 157: 664-7(July 21, 1964). (In Russian)

During radiolysis the oxidizing component is the OH radical, but the reducing component may be a polaron $e^-{\cdot}nH_2O$, which is a free thermalized electron which has reacted with water, or atomic hydrogen which is formed by the following reaction: $H_2 + OH \rightarrow H_2O + H$. The properties of these two particles should differ substantially. Thus, the ratio of the reaction rate constants is 0.5 for the following reactions involving the polaron with H_2O_2 and O_2: $H_2O_2 + (e^-{\cdot}nH_2O) \rightarrow OH + OH^-_{aq}$ and $O_2 + (e^-{\cdot}nH_2O) \rightarrow O^-_{2aq}$. The ratio of the reaction rate constants is 2.2×10^{-3} for the analogous reactions with atomic hydrogen H: $H_2O_2 + H \rightarrow H_2O + OH$ and $O_2 + H \rightarrow HO_2$. The yield for the formation of H_2O_2 was determined as a function of the initial O_2 pressure (0.1 to 10 atm) on irradiating a neutral 10^{-3} M H_2O_2 solution saturated with H_2 at 100 atm. The G yield of H_2O_2 remained constant at 2.45 ± 0.12 mol/100 ev. This behavior indicates that the active reducing particle formed by radiolysis is similar to atomic hydrogen which is formed by reaction $H_2 + OH \rightarrow H_2O + H$. The value of the ratio of the reaction rate constants was found to be $k_2/k_3 < 5 \times 10^{-3}$. The primary radical is probably atomic hydrogen H, but it is also possible that molecular hydrogen is oxidized by the OH radical according to the following equation: $H_2 + OH \rightarrow e^-_{hyd.} + H_2O^+_{hyd.}$ (TTT)

39312 MAKE PHENOL BY RADIATION OF BENZENE. Akibumi Danno (Japan Atomic Energy Research Inst., Tokyo). Hydrocarbon Process. Petrol. Refiner, 43: 131-7 (Apr. 1964).

Studies on the production of phenol by thermal and radio-induced oxidation at high temperature in aqueous benzene solutions containing some metal salts are described. The selected conditions for the process of production of phenol by radiation are listed and a flow-sheet is given. The maximum yield of phenol obtained in the thermal oxidation at high temperatures was 90 mg per 15 ml of water, or 9 wt % of the benzene initially present. In the radioinduced oxidation of benzene at high temperature, the yield of phenol is dependent on the kind of metal salt, temperature of reaction, and pH of the solution. It was concluded that the synthesis of phenol by radiation is still in its early stage and further developments are necessary to attain the successful practical application. (P.C.H.)

39313 RADIATION STABILITIES OF ARYLMETHYLSILOXANES. A. A. Miller (General Electric Research Lab., Schenectady, N. Y.). Ind. Eng. Chem., Prod. Res. Develop., 3: 252-6(Sept. 1964).

Simple and polymeric arylmethylsiloxanes were irradiated with 1.5-Mev electrons and their stabilities compared on the basis of gas yields and viscosity increases at a fixed irradiation dose. Conjugated aromatic substituents, such as biphenylyl and naphthyl, protect the radiosensitive methyl groups more effectively than does a single phenyl group and the protection by any aromatic substituent is greatest when on the same silicon atom as the methyl. The over-all radiation stability against viscosity change and gelation depends upon the crosslinking yield, the initial molecular weight and, for polymeric siloxanes, the end groups. (P.C.H.)

39314 IRRADIATION CROSS LINKING OF POLYETHYLENE. THE TEMPERATURE DEPENDENCE OF CROSS LINKING IN THE CRYSTALLINE AND AMORPHOUS STATES. R. Kitamaru and L. Mandelkern (Florida State Univ., Tallahassee). J. Am. Chem. Soc., 86: 3529-34 (Sept. 5, 1964).

The irradiation crosslinking of molecular weight fractions of polyethylene is studied as a function of the temperature and state of the system. A definite distinction must be made between the temperature and the state of the system since the irradiation temperature has a different effect on the crystalline and amorphous regions. At low temperatures there is essentially no difference in the crosslinking efficiency of a highly crystalline bulk specimen when compared with one in which the crystallinity is not as well developed. However, at temperatures exceeding 100°C the efficiency of crosslinking the highly crystallized specimen increases by a factor of two while the efficiency for the other specimen remains essentially constant. An explanation of these results is offered in terms of the onset of molecular motion among the chain units in the crystalline sequences at this temperature. In addition, it is found that at temperatures where a direct comparison can be made, intermolecular crosslinking is much more easily accomplished in the highly crystalline specimen than in a completely amorphous one. Experiments on the partitioning between sol and gel subsequent to the irradiation of crystals formed from dilute solution are interpreted in terms of these results. (auth)

39315 PHASE TRANSITIONS AND THE RADIATIVE NEUTRON CAPTURE IN SOLID ORGANIC MEDIA. Miriam Milman (Ecole Normale Supérieure, Orsay, France). J. Am. Chem. Soc., 86: 3567-8(Sept. 5, 1964).

In studies of the radiative neutron capture (Szilard-Chalmers effect) in solid dibromoethane, bromotrichloromethane, and other organic halides, it was found that the organic yield of bromine-80 presents a marked dependence on the phase transitions of the corresponding solid organic media. (N.W.R.)

39316 RADIOLYSIS IN THE ADSORBED STATE. Johann Georg Rabe, Birgit Rabe, and Augustine O. Allen (Brookhaven National Lab., Upton, N. Y.). J. Am. Chem. Soc., 86: 3887-8(Sept. 20, 1964). (BNL-8057)

The gamma radiolysis of pure liquid azoethane gave $G(N_2) = 3.69$, $G(H_2) = 0.46$, and $G(CH_4) = 0.076$. When adsorbed on silica gel and radiolyzed, azomethane behaved much like pentane. As the amount of azoethane on the gel was increased, the amount of product formed increased, very rapidly at first, more slowly at higher coverages. On magnesia, the data suggest that the available energy is divided among the molecules present, so that at low coverages some molecules are raised to high states of excitation, while at higher coverages only states of lower energy are formed. Thus with increasing coverage, hydrogen, which requires most energy for its formation, decreases first, then methane, and finally nitrogen, when the average excitation energy available per molecule becomes too small to produce decomposition. Azomethane radiolysis on graphite and nickel and zinc oxides was also studied. The results differ in detail, but in all cases the apparent amount of energy transfer is much less than with the insulators, silica and magnesia. (P.C.H.)

39317 KINETIC THEORY ANALYSIS OF THE REACTION OF HOT HYDROGEN ATOMS WITH PROPANE, BUTANE, AND BUTENE-1. Allan H. Rosenberg and Richard Wolfgang (Yale Univ., New Haven). J. Chem. Phys., 41: 2159-67(Oct. 1, 1964).

The kinetic theory of hot reaction was applied to results on the reaction of hot hydrogen atoms with propane, butane, and butene-1. Recoil tritium, generated by the $^3He(n,p)T$ process served as the source of hot hydrogen. Yields of hot abstraction, displacement, and addition processes were measured by radio gas chromatography. Scavengers were used to suppress interfering thermal processes. Runs were made covering a wide range of moderation of the hot hydrogen by helium. A complete analysis of the data and the use of appropriate internal consistency checks, shows that within experimental error the kinetic theory provides a satisfactory description of the system. Its application serves to express the data in terms of reactivity integrals, I, and collisional energy loss parameters α. In accordance with previous expectations, the magnitudes of these quantities indicate that hot atom collisions are highly inelastic and have a high probability of leading to reaction. (auth)

39318 PULSE RADIOLYSIS STUDIES. VI. THE LIFETIMES OF AROMATIC ANIONS IN THE ALIPHATIC ALCOHOLS. Shigeyoshi Arai and Leon M. Dorfman (Argonne National Lab., Ill.). J. Chem. Phys., 41: 2190-4(Oct. 1, 1964).

The formation and the lifetimes of several aromatic anions in irradiated solutions of arenes in the aliphatic alcohols were investigated by the pulse radiolysis technique. The aromatic anions show a fast decay that follows a first-order rate law. The absolute rate constants for this decay, suggested to be a proton transfer from the alcohol, $arene^- + ROH = arene\ H\cdot + RO^-$, were determined for four alcohols and three aromatic anions. The rate constants, which are found to be in the order $CH_3OH > C_2H_5OH \cong C_3H_7OH > (CH_3)_2CHOH$, show a close correlation with other measurements of the acidity of the alcohols. The absolute rate constants were also determined for the reaction of several aromatic anions with hydrogen ion, $arene^- + ROH_2^+ = arene\ H\cdot + ROH$, and for the attachment reaction of the solvated electron in ethanol, $e^-_{sol} + arene = arene^-$. (auth)

39319 ETHYLENE FROM THE γ-RADIOLYSIS OF CYCLOHEXANE. Shin Sato, Kiyoaki Kikuchi, and Shoji Shida (Tokyo Inst. of Tech.). J. Chem. Phys., 41: 2216-17(Oct. 1, 1964).

The effects of benzene and cyclohexene additives on the ethylene yield in the gamma radiolysis of cyclohexane are discussed. The initial G value for ethylene was determined by the extrapolation technique as 0.12. The initial rise of $G(C_2H_4)$ and $G(C_3H_6)$ is interpreted by the protective action of the additives on the formed olefins from the attack of species successively produced in the system. The fact that the ability of benzene to protect the formed ethylene is much less than that of cyclohexene and cyclo-octatetraene is much stronger than cyclohexene in this ability, suggests that the additives act as radical scavengers when they protect the formed olefins. A reaction mechanism is suggested for the formation of ethylene and for the energy transfer. (P.C.H.)

39320 RADIATION BEHAVIOR OF FERROCENE. B. K. Krotoszynski (Illinois Inst. of Tech., Chicago). J. Chem. Phys., 41: 2220-1(Oct. 1, 1964).

The results of experiments on the radiation behavior of ferrocene in the high-energy electron field are presented. Degassed samples of pure ferrocene were irradiated at approximately 25°C with Mev electrons. The average dose rate was 2.0×10^{20} ev g^{-1} min^{-1}. The gaseous products consisted essentially of hydrogen. The condensable products were tentatively identified as cyclopentadiene and isomeric pentadienes. The constancy of the corresponding G values indicates a linear relationship between the product formation and radiation dosage. The yields of hydrogen, hydrocarbon products, and inorganic iron as a function of radiation dosage are tabulated. (P.C.H.)

39321 THE SZILARD-CHALMERS ENRICHMENT OF IRON-59. Chau-ting Chang and Chien-chang Lin (Tsing Hua Univ., Hsinchu, China). J. Chinese Chem. Soc. (Taiwan), 11: 14-23(May 31, 1964).

Iron-59 with high specific radioactivity was obtained by means of Szilard-Chalmers process. An enrichment factor of as high as 750 was attained when potassium ferrocyanide was used as target material and was irradiated at a neutron flux of 1.8×10^{12} n/sec-cm^2 for 100 hours. However, a lower factor of 130 was obtained when potassium ferricyanide was used instead. Both precipitation and direct extraction with isopropyl ether in hydrochloric acid solution were employed as means of separation. The relation between irradiation time, enrichment factor, and specific activity was also investigated. The radiative decomposition constants of postassium ferrocyanide and ferricyanide were estimated. (auth)

39322 THE PREPARATION OF ^{14}C-LABELLED GIBBERELLIC ACID. A. J. McComb (Univ. of Western Australia, Perth). J. Gen. Microbiol., 34: 401-11(Mar. 1964).

A satisfactory technique for preparing gibberellic acid (GA) labeled with ^{14}C, for use in physiological experiments with higher plants, is outlined. Gibberella fujikuroi was allowed to grow on unlabeled medium until GA was being produced, and samples of mycelium were then transferred

to a substrate containing ^{14}C-acetate. Pure ^{14}C-GA was isolated from the medium. The specific activity of the ^{14}C-GA was increased by transferring mycelium to a second labeled substrate 6 hr after the first transfer. The specific activity was not increased when unlabeled glucose was present in the transfer medium, or when anaerobic conditions were maintained after transfer. Most of the ^{14}C-GA was produced during the 48 hr following transfer. A large portion of the ^{14}C was lost as $^{14}CO_2$, and most of this was produced during the 40 hr after transfer. After this period little GA was produced, but the evolution of unlabeled CO_2 continued. The specific activity of this ^{14}C-GA was high enough to allow studies to be made on the distribution and breakdown of GA in high plants, but further increase in specific activity would be advantageous. It is proposed that this might be achieved by simply supplying more labeled acetate, and also by supplying acetate of higher specific activity, labeled in both the methyl and carboxyl groups. (BBB)

39323 COLOR CENTERS IN γ-IRRADIATED RUBY. Tetsuo Maruyama and Yasuhiko Matsuda (NAIG Nuclear Research Lab., Kawasaki, [Japan]). J. Phys. Soc. Japan, 19: 1096-1104(July 1964).

The color center behaviors of γ-irradiated ruby were studied. The additive absorption spectra due to γ-irradiation are superposition of four bands each peak of which was found to be 220, 280, 370, and 460 mμ. From the observation of formation and annealing processes of these color centers, it is concluded that in aluminum oxide the additional lattice defect can not be created by γ-irradiation and the nominal amount of impurity will determine the color center concentration. The origins of four absorption bands are also discussed and the presence of Cr^{2+} ions are suggested to be probable. (auth)

39324 X-RAY STUDY ON THE RADIATION DAMAGE IN LiF CRYSTALS. Kazuko Kubo, Yoshikazu Hamaguchi, and Haruhiko Motohashi (Japan Atomic Energy Research Inst., Tokyo). J. Phys. Soc. Japan, 19: 1105-9(July 1964).

The reflection intensity of x rays was measured as a function of the distance from the irradiated outer surface to the measured location in a neutron irradiated LiF crystal; the distance was converted to thermal neutron dose. The measurements showed that the reflection intensity monotonically increased with increasing neutron dose. Rocking curves were obtained for LiF specimens, taking the irradiation conditions as parameters. The curves showed that the rocking curve broadened as irradiation proceeded, indicating that the coherent domain became small when neutron irradiated unless the recovery of crystalline defects actively worked. From the results, the extinction coefficient of LiF crystal for x rays is concluded to decrease with neutron irradiation. The decrease of extinction is suggested to be caused by the complex color centers consisting of a cluster of defects. The clustered defects and small dislocation loops, both of which are introduced by heavy neutron irradiation, also work to make the coherent domain in LiF crystals smaller. (auth)

39325 ELECTRON PARAMAGNETIC RESONANCE IN A GAMMA-IRRADIATED SINGLE CYRSTALS OF FERROELECTRIC TRI-HYDROGEN LITHIUM SELENITE. Hideo Iwasaki (Ministry of Posts and Telecommunications, Tokyo). J. Phys. Soc. Japan, 19: 1256-7(July 1964).

Single crystals of tri-hydrogen lithium selenite were irradiated at room temperature with a ^{60}Co gamma source to doses of 2.7×10^6 R. The EPR spectra were observed at 9300 Mc. The characteristics of the g-factors and the direction cosines of the principal coordinates are presented. Although the structures of the paramagnetic centers are not determined completely from the observations, it is believed that these spectra arise from the isolated magnetic molecules produced by the irradiation in the (SeO_3) ions. Evidence supporting this interpretation is derived from the symmetry information, anomalous g-factor shifts, and the fact that hyperfine structure was not observed. (C.E.S.)

39326 SOME ASPECTS OF THERMAL DECOMPOSITION OF POLYOXYMETHYLENE AND IRRADIATED POLYOXYMETHYLENE. Sadao Torikai (Toyo Rayon Co., Ltd., Otsu, Shiga, Japan). J. Polymer Sci., Pt. A, 2: 3461-9(Aug. 1964).

The thermal decomposition of polyoxymethylene and irradiated polyoxymethylene in vacuum was carried out and the kinetic aspects of thermal decomposition discussed. Although decomposition of low viscosity polyoxymethylene followed a pattern in which log (polymer residue) was roughly linear with decomposition time, the high-viscosity polyoxymethylene, which was obtained by the post-polymerization of irradiated solid formaldehyde, showed the two components different in stability. However, the concentrations of the components depended on the decomposition temperature. After the thermal decomposition, the sample could not be further stabilized by acetylation, while this initial polymer could be highly stabilized by acetylation. The irradiated polymer also could not be thermally stabilized by acetylation, though the first component of the irradiated polyoxymethylene disappeared after acetylation. The components of the polymer irradiated at 100°C, ~4 Mr ($\eta_{sp}/c = 0.23$) showed three components the concentrations of which are independent of decomposition temperature. In irradiation at room temperature, or in the case of irradiation by the electron beams from a Van de Graaff generator at a high dose rate, the evacuation at 100°C of the irradiated sample after irradiation disclosed the clear dependence of formation of stable polymer on dose, and the formation of three components, which are independent of the decomposition temperature. (auth)

39327 RADIATION-INDUCED POLYMERIZATION OF 2-METHYL-5-VINYL-PYRIDINE. Yoneho Tabata (Tokyo Univ.), Hirokimi Kitano, and Hiroshi Sobue. J. Polymer Sci., Pt. A, 2: 3639-48(Aug. 1964).

Radioinduced polymerization of 2-methyl-5-vinylpyridine was investigated in bulk in the temperature region of 50 to −196°C. The activation energy was found to be 5.7 kcal/mole for the liquid-phase polymerization and 0.3 kcal/mole for the solid-phase polymerization. It was observed that the rate of polymerization is proportional to the square root of the dose rate in the liquid-phase polymerization and is proportional to the dose rate in the solid-phase polymerization. DPPH and benzoquinone inhibited strongly the liquid-phase polymerization, while the same inhibitors did not inhibit appreciably the solid-phase polymerization. On the other hand, the solid-phase polymerization was completely inhibited by acetone, pyridine, and methanol, while the liquid-phase polymerization was not inhibited by the same additives. It was concluded that the polymerization in the liquid phase proceeds by a radical mechanism and the polymerization in the solid phase proceeds by a nonradical mechanism, probably an ionic or electronic mechanism. (auth)

39328 RADIATION-INDUCED COPOLYMERIZATION OF ACRYLONITRILE WITH STYRENE. Yoneho Tabata (Tokyo Univ.), Yoshio Hashizume, and Hiroshi Sobue. J. Polymer Sci., Pt. A, 2: 3649-55(Aug. 1964).

Radioinduced copolymerization of acrylonitrile with styrene was carried out over a wide range of temperatures. It was found that the rate of copolymerization is proportional to the square root of the dose rate. An apparent activation energy of 6.90 kcal/mole was obtained for the copolymerization in an equimolar mixture of monomers. The rate of copolymerization increased with the molar concentration of acrylonitrile in the monomer mixture. Monomer reactivity ratios were determined as $r_{AN} = 0.03$, $r_{St} = 0.33$ for the copolymerization at 15 and 0°C, $r_{AN} = 0.28$, $r_{St} = 0$ at −20°C in the liquid state of monomers. On the other hand, the monomer reactivity ratios were obtained as $r_{AN} \simeq 0$ and $r_{St} \simeq 0$ for the copolymerization in the solid state at −78°C. It was concluded that there is a great difference between the liquid-state and solid-state copolymerizations, both in the polymerization mechanism and the structure of copolymers. (auth)

39329 RADIATION CHEMISTRY OF IODINE-OCTAMETHYLCYCLOTETRASILOXANE SOLUTIONS. Clarence J. Wolf and A. C. Stewart (Union Carbide Corp., Parma, Ohio). J. Polymer Sci., Pt. A, 2: 3781-90(Aug. 1964).

Post-irradiation polymerization of γ irradiated liquid octamethylcyclotetrasiloxane containing a small amount of iodine was observed. The effect occurs at room temperature without an additional stimulus, and it was concluded that it results from catalysis by HI_3, i.e., a complex of $HI + I_2$. Hydrogen triiodide is produced when iodine-octamethylcyclotetrasiloxane solutions are irradiated with γ rays from ^{60}Co. HI_3 is a good rearrangement catalyst for siloxane bonds. The dose is critical; short irradiations do not produce enough HI, while longer irradiations consume most of the I_2. The triiodide complex dissociates at temperatures equal to or greater than 60°C; thus, the polymerization stops as the temperature is raised, but contrary to usual post-irradiation polymerization processes, resumes when the sample cools. Pure irradiated octamethylcyclotetrasiloxane polymerizes upon the addition of iodine. It is assumed that the irradiation produces silicon–hydrogen bonds that react with iodine yielding the catalyst HI_3. In all systems the HI_3 was identified spectrophotometrically. However, its role in the polymerization was established directly when it was determined that an unirradiated iodine-octamethylcyclotetrasiloxane solution polymerized upon the addition of HI. (auth)

39330 PULSE RADIOLYSIS APPARATUS. J. P. Keene (Paterson Labs., Christie Hospital and Holt Radium Inst., Manchester, Eng.). J. Sci. Instr., 41: 493-6(Aug. 1964).

Apparatus for investigating the kinetics of radiation induced chemical reactions is described. It is used with a 4 Mev linear electron accelerator which is arranged to give any dose from a few tens of rads up to about 10 kilorads, to a small liquid sample in a single pulse lasting either 2.0 or 0.2 μsec. An optical system, in conjunction with a light source, a photodetector, and a cathode-ray oscilloscope, is used to investigate the time variation in concentration of optically absorbing chemical species produced by the radiation. The importance of proper design of the optical system, if maximum sensitivity is required, is stressed. Shot noise in the photodetector is a natural limitation to the sensitivity of the method, when measurements are made in the microsecond region, and it is therefore necessary to get as much light as possible through the irradiation cell. (auth)

39331 ELECTRON SPIN RESONANCE STUDIES OF IRRADIATED POLYETHYLENE. II. CONSIDERATIONS ON THE DECAYS OF FREE RADICALS. Hisatsugu Kashiwabara (Hokkaido Univ., Sapporo). Japan J. Appl. Phys., 3: 384-9(July 1964).

Decays of the free radicals of an alkyl type trapped in irradiated polyethylene were investigated by means of the electron spin resonance method. It was found that, in the temperature range from 77 to 350°K, there are three regions of temperatures, near 140, 200, and 240°K, at each of which alkyl type free radicals decay rather transitionally. These regions correspond to the temperature regions of mechanical dispersions in polyethylene except that near 200°K. Decays of the free radicals were considered in connection with the molecular motion of polyethylene associated with the mechanical dispersion. The relations between the narrowing of line width and the decay of free radicals were also considered briefly. (auth)

39332 ON THE MECHANISM OF THE SO-CALLED X-RAY COLORATION OF IONIC CRYSTALS. M. Balarin (Zentralinstitut für Kernforschung, Rossendorf, Ger.). Kernenergie, 7: 434-43(June-July 1964). (In German)

The electronic processes responsible for the coloration assumed by ion crystals when irradiated with low-energy x rays were investigated. Elastic collisions were found to occur in the form of focusing chains; these collisions, in turn, cause defects in crystal structure. Voids and interlattice atom inclusions take place, especially in the (110) direction. The kinetic energy of the atoms is imparted by photoelectrons. Various theories advanced for the explanation of this discoloration are compared and critically evaluated in the light of the observations presented. The only defects occurring were anion lattice distortions. They generally occurred in the intact crystal volume, but could also be found at pre-existing imperfections of the lattice. (M.C.G.)

39333 SOME ENGINEERING-PHYSICAL PROBLEMS IN THE DESIGN OF RADIATION-CHEMICAL EQUIPMENT. N. P. Syrkus. Khim. Prom., No. 2, 134-41(1964). (In Russian)

Equations and graphs are presented for the effect of the conditions of irradiation on the productivity of radiation-chemistry equipment, for the productivity half life of such equipment, and for the technological and economical factors determining the selection of the optimum parameters of the equipment. (P.C.H.)

39334 THE EFFECT OF GAMMA-IRRADIATION ON AQUEOUS SOLUTIONS OF TRIGLYCINE. I. SPECTROPHOTOMETRIC STUDY OF IRRADIATED TRIGLYCINE. Charles A. Leone (Univ. of Kansas, Lawrence) and Man Sik Kang. Korean J. Zool., 6: No. 2, 16-20(Dec. 1963).

Gamma irradiated aqueous solutions of triglycine were studied using spectrophotometric techniques and uv absorption studies. The dose yield data for irradiated triglycine-biuret complex showed a typical dose-yield curve for indirect action of radiation. The G value of peptide bond rupture in irradiated aqueous solution of triglycine was found to be 1.75. The dose-yield data for irradiated triglycine-biuret complex indicated a decreasing rate of peptide bond rupture with increasing dose showing the successful competition of the products for the free radicals. The molecular extinction coefficient of irradiated triglycine increased proportionally with the dose up to 5×10^{20} ev/ml and at higher doses the molecular extinction coefficient decreased linearly with increasing dose up to 1.9×10^{21} ev/ml. From these data, the G value for carbonyl compound was found to be 0.80. (auth)

39335 THE MICROSYNTHESIS OF ^{82}Br-LABELLED 2-BROM-D-LYSERGIC ACID DIETHYLAMIDE (BOL).

D. A. Kalbhen (Universität, Bonn). Med. Exptl., 9: 20-4 (1963).

To be able to study the distribution and fate of BOL in humans, it was necessary to synthesize a labeled BOL with a bromine isotope whose properties of half life and energy would permit human experiments. Bromation with molecular bromine was attempted because the Br isotope was only available in the form of $K^{82}Br$ with a half life of 35.9 hr. Test runs showed that in addition to BOL some bromine adducts, as well as breakdown products, of LSD were also obtained. Through an empirical study of reaction conditions it was possible to get chromatographically pure ^{82}Br-LSD in amounts sufficient for biologic studies. The apparatus and the procedure used are described in detail. To 7 mg $K^{82}Br$ dissolved in 0.8 ml H_2O (radioactivity about 4 mC) 0.5 ml of 50% H_2SO_4 was added in a 30-ml three-necked round bottom flask and heated to 50° to 60°C. Through an inlet capillary tube that reached down into the KBr solution, 0.5 ml of 30% H_2O_2 solution was added to the mixture. The liberated Br was carried with the stream of air from this flask(I) into a second flask(II) that contained a solution of 10 mg LSD in 5 ml of CH_2Cl_2. To carry as much Br as possible into the LSD solution, after each 15-min interval of reaction time 3 ml of CH_2Cl_2 was dropped slowly from a dropping funnel into flask I. At the temperature of 50 to 60°C the CH_2Cl_2 was vaporized and so distilled into flask II, removing bromine vapor with it. In flask II the Br is dissolved in the CH_2Cl_2 and reacts with the LSD. After 40 min the solution in flask II was added to 5 ml of 2% $KHCO_3$ solution in a separatory funnel and the solution was shaken. The carbonate solution was then shaken twice with 5 ml of pure CH_2Cl_2. The combined methylene chloride phases were evaporated under vacuum. ^{82}Br-BOL was then separated from this concentrated solution by chromatography on alumina plates. The yields were between 0.7 and 1.7 mg BOL (5 to 15% yield based on LSD) with a sp act. of 625 to 400 μC/mg BOL. (BBB)

39336 STUDIES ON THE PREPARATION OF ION-EXCHANGE MEMBRANES BY RADIATION-INDUCED GRAFT POLYMERIZATION WITH THE AID OF ELECTRON RADIATION FROM A VAN DE GRAAFF GENERATOR. L. Wuckel (Institut fur Angewandte Physik der Reinstoffe der Deutschen Akademie der Wissenschaften, Dresden), H.-J. Heinreich, H. Langner, E. Sporkenbach, and T. Czvikovszky. Monatsber. Deut. Akad. Wiss. Berlin, 6: 484-6(1964).

High-pressure polyethylene foil samples, from 0.2 to 0.6 mm thick, were exposed to electron irradiation in the 0.5 to 1.8 Mev energy range, at 5 to 250 μA, corresponding to a dosage rate of 10^7 to 5×10^8 rad/hour. The degree of grafting was studied in relation to temperature, duration of the irradiation, and storage time following irradiation. The data obtained were utilized to establish the parameters for a continuous polymerizing process. (OTS)

39337 FORMATION OF FREE RADICALS IN UV-IRRADIATED CELLULOSE; BRIEF COMMUNICATION. Theodor N. Kleinert. Monatsh. Chem., 95: 387-9(1964). (In German)

See abstract of complete report from Holzforschung, 18: 24-8(Apr. 1964). (BBB)

39338 RADIATION CHEMICAL REACTIONS IN DEOXYGENATED PEPTIDE SOLUTIONS. J. Liebster and J. Kopoldova (Inst. of Biology, Czechoslovak Academy of Sciences, Prague). Nature, 203: 636-7(Aug. 8, 1964).

Gamma radiolysis studies were made on 0.05 M oxygen-free solutions of leucyl-glycyl-glycine (leu.gly.gly), leucyl-glycine (leu.gly), glycyl-leucine (gly.leu), glycine, leucine, and a mixture (1 : 1) of 0.025 M glycine and 0.025 M leucine. The results showed that recombination is the predominant reaction in irradiated deoxygenated peptide solutions. The recombination reactions observed with peptides are analogous to those observed with free amino-acids. In the presence of an aliphatic amino-acid with longer chain, breakage of the peptide bond is practically completely suppressed in favor of recombination as demonstrated by the small amount of carbonyl compounds and amino acids in the irradiated solutions. (P.C.H.)

39339 RADIATION-INITIATED POLYMERIZATION. PART 3. TWO FLUOROPOLYMERS WITH COMMERCIAL POTENTIAL. P. J. Manno (Continental Oil Co., Houston, Tex.). Nucleonics, 22: No. 9, 72-6(Sept. 1964).

The effects of several parameters in the polymerization of vinyl fluoride and the copolymerization of chlorotrifluoroethylene and ethylene under gamma irradiation were determined. Comparisons with typical catalytic processes revealed definite advantages for the radiation processes. (D.C.W.)

39340 THERMOLUMINESCENCE OF X-RAY AND ULTRAVIOLET EXCITED CsBr CRYSTALS. William A. Butler, Robert A. Reitz, Roger B. Rusert, and William T. Ford (Carleton Coll., Northfield, Minn.). Phys. Rev., 136: A141-4(Oct. 5, 1964).

Thermoluminescence produced both by x irradiation of uncolored crystals and by ultraviolet irradiation of additively colored single crystals of CsBr was studied. Glow curves were obtained over the temperature range of 90–400°K and correlated with F-band absorption. A small amount of thermoluminescence was found in nonadditively colored crystals subjected to intense ultraviolet radiation. Glow-peak temperatures and activation energies are listed. (auth)

39341 APPLICATION OF THE SUCCESSIVE LABELLING TECHNIQUE TO SOME CARBON, NITROGEN AND CHLORINE ISOTOPE EFFECT STUDIES OF ORGANIC REACTION MECHANISMS. Arthur Fry (Univ. of Arkansas, Fayetteville). Pure Appl. Chem., 8: 409-19(1964).

Applications of the successive labeling technique to isotope effect studies of reaction mechanisms are discussed. The Dieckmann Condensation, Wolff Rearrangement, and the S_N2' reaction were used. From the example given, it is clear that the successive labeling isotope effect technique can provide much useful information about reaction mechanisms. With no more than qualitative and semiquantitative consideration of theory, where practical, is bound to give even more meaningful results. (P.C.H.)

39342 ABNORMAL TRITIUM ISOTOPE EFFECT IN THE ADDITION OF HYDROGEN ATOMS TO LIQUID UNSATURATED HYDROCARBONS. J. Y. Yang and J. G. Burr (North American Aviation Science Center, Thousand Oaks, Calif.). Pure Appl. Chem., 8: 427-33(1964).

Tritium isotope effects were determined in hydrogen atom addition reactions by measuring the specific activities of the saturated hydrogen corresponding to the olefin and the dimer of the radical formed and comparing them with the specific activity of the solvent saturated hydrocarbon. The isotope effects were determined in three solvent-solute pairs: tritiated cyclohexane–benzene; tritiated n-octane–cyclohexane; and tritiated cyclohexane–cyclopentene. The radiolysis of each mixture is discussed separately. The over-all reaction in the irradiated liquid cyclohexane-cyclopentene mixture consists in the transfer of hydrogen atoms from cyclohexane to cyclopentene. Thus, tritium

enrichment factor amounts to the observation that tritium atoms are transferred faster than hydrogen atoms and therefore represents an abnormal isotope effect. (P.C.H.)

39343 RADIATION DAMAGE IN DRY RIBONUCLEASE: YIELDS OF FREE RADICALS AND OTHER CHEMICAL LESIONS COMPARED WITH INACTIVATION EFFICIENCY. J. W. Hunt and J. F. Williams (Univ. of Toronto). Radiation Res., 23: 26-52(Sept. 1964).

The yield of free radicals produced in irradiated samples of dry, purified ribonuclease was measured over a wide range of doses. The yield of one class of radicals was correlated with the change in the sensitivity of the enzymatic activity for irradiation in oxygen and in vacuum, and for postirradiation treatment with oxygen. The rate of production of sulfur-type radicals was also measured and correlated with the yield of free SH groups measured by titration with pOHMB. These free SH groups were tentatively identified with broken disulfide bridges. A comparison between the kinetic parameters of irradiated and native ribonuclease revealed no changes in the Michaelis constant. In addition, the chromatographic separation of damaged and active fractions of the enzyme gave no indication of altered but still active molecules. The spectrophotometric titration of tyrosyl groups revealed that some groups are unmasked by the radiation, probably owing to the opening up of the tight molecular configuration. (auth)

39344 HYDROGEN ATOMS AND SOLVATED ELECTRONS IN IRRADIATED AQUEOUS SOLUTIONS AT 77°K. Thormod Henriksen (Norsk Hydro's Inst. for Cancer Research, Montebello, Norway). Radiation Res., 23: 63-77 (Sept. 1964).

Radiation-induced radicals in water as well as in acid and alkaline aqueous solutions were studied by ESR spectroscopy. The formation of H atoms and solvated electrons was given particular attention. Frozen solutions, both glassy and polycrystalline, were irradiated at liquid nitrogen temperature, and the ESR spectra were recorded at about 80°K. It was found that the number of ESR centers trapped depends on the physical state of the solution. Thus, two to four times as many radicals are trapped in the glassy samples as in the polycrystalline ones. Evidence was obtained that solvated electrons possess a resonance line at a g value slightly below that of the free spin and with a width that depends on the solvation medium. These ESR centers were only observed in alkaline solutions where a maximum yield (G value) of about 2.6 was found. The yield of solvated electrons for glassy solutions may be about twelve times as large as that for a corresponding crystalline solution. Radiation-induced H atoms were observed in both acid and alkaline solutions. Whereas for acid solutions the largest yield was observed for glassy samples, the opposite was found for alkaline solutions. The results seem to indicate that OH radicals are formed and trapped in neutral water as well as in acid and alkaline solutions at concentrations up to about 1 mole/l. The results seem to indicate that both the Lea-Gray-Platzman and the Samuel-Magee mechanisms for the formation of water radicals are operative in frozen alkaline solutions, the former being the most important. (auth)

39345 INTERMOLECULAR AND INTRAMOLECULAR ENERGY TRANSFER IN GAMMA-IRRADIATED ALKYLBENZENES AND RELATED MIXTURES. Kent H. Jones, William Van Dusen, Jr., and Leslie M. Theard (Sandia Lab., Albuquerque, N. Mex.). Radiation Res., 23: 128-34 (Sept. 1964).

Hydrogen yield, $G(H_2)$, was determined for the γ-ray-induced decomposition of the n-alkylbenzenes from toluene through n-octylbenzene, isopropylbenzene, and iso-, sec-, and tert-butylbenzene. Values of $G(H_2)$ vary from 0.12 for toluene to 0.33 for n-octylbenzene and generally increase with increasing size of the alkyl group. However, the number of molecules of hydrogen produced per 100 ev of energy absorbed by the alkyl group, $g_{alkyl}(H_2)$, is approximately 0.5 for all the alkylbenzenes studied (with the exception of tert-butylbenzene) and thus suggests that protection by phenyl groups is independent of side chain size. The number of molecules of hydrogen formed per 100 ev of energy absorbed by the alkane, $g_{alkane}(H_2)$, for solutions of n-butane in benzene and n-hexane in benzene has been determined over the full concentration range. The extrapolated value of $g_{alkane}(H_2)$ for infinitely dilute solutions of alkane in benzene for both systems studied is 0.5. Equality of this value with values of $g_{alkyl}(H_2)$ suggests equal effectiveness of intermolecular and intramolecular energy transfer by benzene and phenyl groups, respectively. (auth)

39346 MONTE CARLO CALCULATIONS ON MODELS FOR HIGH ENERGY ATOMIC REACTIONS. I. SINGLE REACTIVE COMPONENT SYSTEMS, MODERATOR EFFECTS. F. S. Rowland and P. Coulter (Univ. of Kansas, Lawrence). Radiochim. Acta, 2: 163-72(July 1964).

A Monte Carlo calculation was performed to evaluate the yields expected from the kinetic theory of hot atom reactions for various combinations of parameters. The calculations were performed for the elastic, isotropic model and for an isotropic, pseudoelastic model in which the maximum energy loss is treated as a free parameter. The total hot yield, Y, is given for a pure compound with sufficient accuracy to be useful by the formula $Y = 1 - \exp(-I/\alpha)$. The hot yield from recoil tritium reaction with A diluted by helium is approximately given by $Y_A = 1 - \exp(-f_A I_A/\alpha_{AB})$. This formula fails to describe recoil tritium behavior in other inert gases because of changing values of α_{AB} in the reactive chemical range. (auth)

39347 ISOTOPE EFFECT IN NEUTRON-INDUCED NUCLEAR REACTIONS IN GERMANIUM COMPOUNDS. E. Merz (Kernforschungsanlage, Julich, Ger.). Radiochim. Acta, 2: 172-9(July 1964). (In German)

An isotope effect was observed on the chemical recoil products isolated following (n,γ)- and (n,2n)-reactions in metallorganic compounds of germanium. In the irradiation of Ge-tetraphenyl with thermal neutrons, variations in the $^{71}Ge/^{77}Ge$ isotope ratio were measured for the solid compound (up to 9%) as well as when dissolved in cyclohexane and benzene, respectively (up to 8%). The effect also appeared in liquid Ge-diphenyl (up to 6%). Likewise, definite variations in the $^{69}Ge/^{75}Ge$ isotope ratio were detected in the (n,2n)-process on solid Ge-tetraphenyl (up to 10%). The effect seems to be more distinct for irradiations in the solid compared to the liquid. The possible reasons for the occurrence of the observed isotope effect are discussed. (auth)

39348 KINETIC ANALYSIS OF HOT BROMINE ATOM REACTIONS IN LIQUIDS. Miriam Milman (Faculte of Sciences, Orsay, France). Radiochim. Acta, 2: 180-8(July 1964).

The yield of organically bound radiobromine was determined in a wide range of mixtures of benzene, hexane, cyclohexane, tetradecane, and bromoform with molecular bromine. The data were analysed by applying the kinetic theory of hot reactions to these liquid systems. After a

number of drastic assumptions it was found possible to express the data in terms of two parameters: the reactivity integral (I) and the collisional energy loss (α). The validity of the independently obtained parameters (α and I) was checked by the determination—both experimentally and theoretically—of the organic yield of hot reactions in mixtures of bromoform and benzene. The values found for the α's indicate that moderating collisions with hydrocarbon involve the whole molecule, whereas with halocarbons the collisions have more of an atom-atom character. (auth)

39349 STABILITY OF ^{32}P-LABELLED PYROPHOSPHATE. Alcides F. Rega (Universidad, Buenos Aires), Ricardo A. Caro, and Renato Radicella. Radiochim. Acta, 2: 218-19(July 1964).

The stability of pyrophosphate (^{32}P) under different conditions was studied. The radiochemical purity of pyrophosphate decreased when amounts of labeled orthophosphate smaller than 15 μm were used for the preparation. Aqueous solutions containing 2.5 μm of pyrophosphate per ml were prepared with different pH values and stored for various periods of time. A pH 10.0 solution heated for 1 hr at 100°C in a sealed ampoule showed no evidence of decomposition. The results indicate that it is possible to store alkaline aqueous solutions of pyrophosphate (^{32}P) at a pH = 8.5 or higher, without any significant change in its radiochemical purity, over normal periods of use. (P.C.H.)

39350 EFFECT OF CRYSTAL STRUCTURE ON ANNEALING OF ^{64}Cu RECOIL ATOMS IN COPPER PHTHALOCYANINE. Kenji Yoshihara and Hiroshi Ebihara (Japan Atomic Energy Research Inst., Tokyo). Radiochim. Acta, 2: 219-20(July 1964).

A striking effect of the crystal structure was found on the annealing of ^{64}Cu recoil atoms produced by (n,γ) and (γ,n) reactions; that is, recoil atoms in irradiated β crystals were very sensitive to annealing at least if expressed as a fraction of the total activity produced while those in α crystals were relatively insensitive. Considering that the β form has a structure with closer packing than the α form, lattice strain will more strongly exist in the neighborhood of ^{64}Cu recoil atoms in the β form than in the α form. Thus annealing proceeds more rapidly in the β crystals than in the α crystals. (P.C.H.)

39351 PULSE RADIOLYSIS OF POTASSIUM BROMIDE SOLUTIONS. B. Cercek, M. Ebert, J. P. Keene, and A. J. Swallow (Christie Hospital and Holt Radium Inst., Manchester, Eng.). Science, 145: 919-20(Aug. 28, 1964).

After application of a 2-microsecond pulse of an electron beam to aqueous, aerated, acid solutions of KBr, transient spectra of Br_2^- and Br_3^- were observed. The kinetic analysis of the reactions as well as the measured values of $G(H_2O_2)$, $G(Br_2)$, and $G(Br_3^-)$ revealed a reaction mechanism differing from the one that is accepted for radiolysis at low intensity. (auth)

39352 THE EFFECTS OF GAMMA RADIATION ON THE CHEMICAL PROPERTIES OF METHYL CELLULOSE. Florine A. Blouin, Vega J. Ott, Trinidad Mares, and Jett C. Arthur, Jr. (Dept. of Agriculture, New Orleans). Textile Res. J., 34: 153-8(Feb. 1964).

Methyl cellulose was irradiated in a solid state in air with gamma radiation from ^{60}Co to dosages of 1, 10, 15, 25, and 50×10^6 R. Irradiation induced chain cleavage, demethylation, and carbonyl and acid group formation in the methyl cellulose. Peroxides and formaldehyde were detected in the irradiated materials. A marked postirradiation loss in acid groups was observed in the irradiated methyl cellulose. No changes in chain length or carbonyl content of the irradiated samples were observed during postirradiation storage. Radiochemical analyses of irradiated methyl-^{14}C celluloses indicated that there were no postirradiation demethylations or losses of oxidized products originating in the methyl groups. Comparisons of radiochemical yields on irradiation of cellulose and methyl cellulose in air to a dosage of 50×10^6 R indicated that methyl cellulose had higher yields of chain cleavage and acid groups and lower yields of carbonyl groups than cellulose. (auth)

39353 ENERGY TRANSPORT BETWEEN CARBOHYDRATES AND METAL CARBONYLS. II. REPORT ON RADIATION CHEMISTRY STUDIES ON METAL CARBONYLS. Helmut Barzynski and Dieter Hummel (Universität, Cologne). Z. Physik. Chem. (Frankfurt), 39: 148-59(1963). (In German)

The effects of ^{60}Co gamma radiation on mixtures of cyclohexane with iron pentacarbonyl or nickel tetracarbonyl were investigated. The G-values of the most important reaction products, cyclohexene, dicyclohexyl, carbon monoxide, di-iron enneacarbonyl, tri-iron dodecacarbonyl, and elemental nickel, and their dependence on the mixture ratio and on the absorbed radiation energy were determined. The results showed that the energy primarily absorbed by the cyclohexane was transferred in part to the metal carbonyl. The mechanism of the reaction was studied. (tr-auth)

39354 THE ROLE OF RADIATION CHEMISTRY IN THE INVESTIGATION OF ABSOLUTE RATE CONSTANTS. Zbigniew Pawel Zagorski (Inst. for Nuclear Research, Polish Academy of Sciences, Warsaw). Wiadomosci Chemi., 18: 391-412(July 1964). (In Polish)

The achievements of radiation chemistry in the estimation of relative reaction rate constants are reviewed. Special attention was paid to work performed with short pulses of high-energy electrons enabling direct determination of absolute rate constants of certain very reactive intermediates of chemical reactions. (auth)

39355 THE INFLUENCE OF GAMMA-RADIATION DOSE ON THE RADIOLYSIS OF AQUEOUS SOLUTIONS OF TRYPTOPHAN, PROLINE, ASPARAGINIC AND GLUTAMIC ACIDS. A. P. Ibragimov and Kh. Mirzarakhmatov (Lab. of Radiation Chemistry, USSR). p.81-7 of "Radiatsionnye Effekty v Biologischeskikh Sredakh i Organizmakh i Metody ikh Issledovaniya." Tashkent, Publishing House of the Sciences, 1964. (In Russian)

The stronger the γ dose the slower the deamination process in aqueous solutions of tryptophan, proline, asparaginic, and glutamic acids. The chromatograms of asparaginic and glutamic acids are similar to that of tryptophan. The pH for asparaginic acid irradiated with 1.4×10^6 R at 18 R/sec is 4.35; at 100 R/sec, 3.72, and at 500 R/sec, 3.6. Similar changes in pH were observed with proline, tryptophan, and glutamine acids. (R.V.J.)

39356 CONCENTRATION AND TEMPERATURE EFFECTS ON THE RADIOLYSIS OF AQUEOUS UROTROPINE SOLUTIONS. D. Khalikov and R. A. Ten (Lab. of Radiation Chemistry, USSR). p.92-6 of "Radiatsionnye Effekty v Biologicheskikh Sredakh i Organizmakh i Metody ikh Issledovaniya." Tashkent, Publishing House of the Sciences, 1964. (In Russian)

Gamma radiation effects on urotropine solutions irradiated at −30°C and the formation of H_2O_2 and H_2 in the presence of oxygen were studied. In oxygen-saturated solutions the contents of H_2 and H_2O_2 increased with tempera-

ture. Irradiation of urotropine with 10^5 and 5×10^5 R at low temperatures revealed no destruction. (R.V.J.)

39357 RADIOLYSIS OF THE AQUEOUS SOLUTIONS OF TYROSINE AND PHENYLALANINE AS A FUNCTION OF THEIR CONCENTRATION AND RADIATION DOSE. T. A. Brodskaya and A. P. Ibragimov (Lab. of Radiation Chemistry, USSR). p.97-106 of "Radiatsionnye Effekty v Biologicheskikh Sredakh i Organizmakh i Metody ikh Issledovaniya." Tashkent, Publishing House of the Sciences, 1964. (In Russian)

Effects of radiation on 10^{-3} to 10^{-1}M phenylalanine and tyrosine in 1% HCl solutions gamma-irradiated in an oxygen media at 465 R/sec at 37 to 41°C to 5×10^6 to 5×10^7 R and fast neutron-irradiated in a reactor at 1.8×10^{13} n/cm^2/sec for 10, 20, 30, 60, and 120 min were studied. Studies were also made of ammonia, hydrogen peroxide, and other decomposition products. The experiments showed that decomposition in 10^{-3} to 10^{-2}M solutions is very high and is dose dependent. (R.V.J.)

39358 EFFECTS OF ^{60}Co γ IRRADIATION ON GOSSYPOL. R. A. Ten and A. P. Ibragimov (Lab. of Radiation Chemistry, USSR). p.131-5 of "Radiatsionnye Effekty v Biologicheskikh Sredakh i Organizmakh i Metody ikh Issledovaniya." Tashkent, Publishing House of the Sciences, 1964. (In Russian)

Radiation effects on gossypol were studied using weak solutions (5×10^{-5}M) of gossypol with 10% high-fraction petroleum ether in a heptane solvent irradiated at 18 R/sec at 26°C. The optical density of gossypol as a function of radiation dose is tabulated, and the yield of gossypol from the aldehyde group and naphthalene ring is indicated. (R.V.J.)

39359 EFFECTS OF GAMMA RAYS ON THE HIGHER FATTY ACIDS AND COTTON OIL. Ya. Kh. Turakulov, A. P. Ibrazimov, and Sh. Aripdzhanov (Lab. of Radiation Effects, USSR). p.121-7 of "Radiatsionnye Effekty v Biologicheskikh Sredakh i Organizmakh i Metody ikh Issledovaniya." Tashkent, Publishing House of the Sciences, 1964. (In Russian)

Effects of γ radiation on fatty acids and cotton oil were studied using stearin, palmitin, olein, and linolein gamma-irradiated at 1.59×10^{18} ev/sec. The oleic and linoleinic acids are less radioresistant than palmitin and stearin. An attempt to use ionization radiation as an agent for cool sterilization showed that high-dose irradiation in a vacuum or in nitric acid media is possible without peroxide formation. Under γ radiation glyceride oils disintegrate into free fatty acids, glycerine, and other products. Saturated glycerides disintegrate faster than nonsaturated. A post-irradiation effect was observed during cotton oil irradiation. (R.V.J.)

39360 CHEMICAL PROCESSING BY RADIATION. David E. Harmer (Dow Chemical Co., Midland, Mich.). 19p. (CONF-558-2).

From Radiation Processing Symposium, Buffalo, May 1964.

A review is presented on the chemical processing by radiation with special attention on ethyl bromide. Choice of processes, development of process, and operation of the process are discussed. Other processes in the pilot plant stage are briefly mentioned. (P.C.H.)

39361 RADIATION EFFECTS ON TEFLON AND TEFLON-BASED MATERIALS AT LIQUID-HYDROGEN TEMPERATURES. W. Weleff, H. S. McQueen, and W. E. Emmons (Aerojet-General Corp., Azusa, Calif.). 24p. (CONF-446-28).

From American Nuclear Society 10th Annual Meeting, Philadelphia, June 1964.

Studies were made on Teflon (TFE), Armalon (a laminate of glass cloth impregnated with Teflon), and Rulon A (fiber-filled Teflon) to determine the effects of different radiation doses on the tensile strength, elongation, and area reduction of these materials while they were immersed in liquid hydrogen. Based upon the observed tensile strength and elongation, and different levels of irradiation, the Teflon appears usable for applications in a liquid hydrogen environment at radiation doses up to 5×10^8 ergs/g. The results for Armalon are very similar to those of Teflon. While the materials are embrittled by the radiation, the residual strength and ductility would still be adequate for many applications. Use of Rulon A should be restricted to applications not requiring a significant ductility in these environments due to the severe embrittlement that occurs. (P.C.H.)

Separation Processes and Procedures

39362 (AAEC/TM-238) THE EXTRACTION OF ANIONIC BERYLLIUM COMPLEXES BY TRIISOOCTYLAMINE. II. THE EFFECT OF THE DILUENT. J. Aggett (Australia. Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales). Mar. 1964. 9p.

Extraction coefficients were measured for the bis(oxalato)-beryllium (II) ion, using solutions of triisooctylamine in various diluents. The heats of mixing amine and diluent were also measured. Disregarding sign, the maximum values obtained for the heats of mixing lie in the order of the diluents' efficiencies in promoting Be extraction. (auth)

39363 (ANL-6831) NUCLEAR CRITICALITY CONTROL IN THE EBR-II FUEL CYCLE FACILITY. J. C. Hesson and L. Burris, Jr. (Argonne National Lab., Ill.). Apr. 1964. Contract W-31-109-eng-38. 35p.

An investigation was made of criticality problems that might be encountered in the EBR-II Fuel Cycle Facility. The purpose of the investigation was to determine quantity and configuration limits for EBR-II fuel of the first core composition during storage, handling, and processing of the fuel material in the EBR-II Fuel Cycle Facility. Brief consideration was also given to criticality problems that might be encountered in processing future EBR-II cores that are expected to contain plutonium as a fissionable material. The philosophy adopted was the establishment of maximum quantities of fuel materials that could be handled, without risk of a nuclear incident, in all fuel processing operations under assumed conditions of "full reflection" and with a safety factor of greater than two to take care of inadvertent double batching. The assumption of "full reflection" (water at least 3 in. thick or its nuclear equivalent) obviates the need for consideration of the proximity of materials other than fuel or fissionable material. Since "full reflection" is not easily achieved, the assumption that "full reflection" exists provides a considerable safety factor. (auth)

39364 (ANL-6874) THE EBR-II SKULL RECLAMATION PROCESS. PART II. OXIDATION OF MELT-

REFINING SKULLS. T. R. Johnson, R. D. Pierce, L. Burris, Jr., and R. K. Steunenberg (Argonne National Lab., Ill.). Apr. 1964. Contract W-31-109-eng-38. 47p.

Part I of this series is ANL-6818.

Discharged fuel from the first core of the Second Experimental Breeder Reactor (EBR-II) will be an enriched uranium–fissium alloy and will be processed by melt refining. In the melt-refining process, the metallic fuel is melted in a zirconia crucible and liquated for about three hours at 1400°C, a procedure that removes most of the fission products through volatilization and oxidative slagging. When the purified metal product is poured into a mold to form an ingot, about 5 to 10% of the charge remains in the crucible as a skull (a mixture of oxides and unpoured metal). Among various methods investigated for removing skull material from crucibles for further processing, the most satisfactory technique consisted of oxidizing the skull in a 20 vol % oxygen–argon mixture at temperatures of 700 to 800°C. This procedure results in the formation of a free-flowing oxide powder that can be poured from the crucible with recoveries of about 98%. Iodine appears to be the only major fission product to undergo significant volatilization under these conditions. The product of the oxidation procedure has been found to have satisfactory properties for further processing by the liquid-metal methods used in subsequent steps of the skull-reclamation process. Plant-scale equipment for the oxidation of skulls has been built and tested, and is being installed in the EBR-II Fuel Cycle Facility in Idaho. (auth)

39365 (HW-78987(Rev.)) SEPARATION OF TRIVALENT RARE EARTHS FROM CERIUM. L. A. Bray and F. P. Roberts (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Oct. 1963. Contract AT(45-1)-1350. 17p.

A process was developed for the separation of Ce from the rare earths. The integrated process includes the coextraction of the rare earths and Ce(III) into 0.4M di(2-ethylhexyl)phosphoric acid (D2EHPA), diluted with 0.2M tri-n-butyl phosphate (TBP) and kerosene, from an aqueous feed solution containing a suitable complexing agent and pH range to free the wanted products from other ions. The Ce-rare earth loaded organic phase is then contacted either batch-wise or in a continuous contactor with an aqueous solution containing 0.2M potassium persulfate oxidant, 0.005 to 0.02M silver catalyst, and 1 to 2M nitric acid. Under these conditions, Ce is oxidized to Ce(IV) and remains in the organic phase while Pm and the other trivalent rare earths are stripped into the aqueous phase. Other concentrations of persulfate, silver, and HNO_3 were also found to be usable, but less favorable separations were obtained for batch extraction conditions. Following phase separation, pure Ce(IV) undergoes reduction and is removed from the organic phase (by contracting with a dilute acid) as a highly purified product. Pm and the other rare earths (now free from Ce), which have stripped into the aqueous solution, are readily available for further processing by a combination of concentration, solvent extraction, and ion exchange. The process produces a Ce product of high chemical and radiochemical purity requiring minimum purification before packaging. The trivalent rare earth product containing Pm will be free from isotopes which generate penetrating radiations and large amounts of heat, thus minimizing the problems of heat dissipation and shielding. The product is also suitable as a feed for rare earth separation processes using organic ion exchange resins. (auth)

39366 (HW-81950) DECLADDING AND DISSOLUTION OF IRRADIATED PRTR ZIRCALOY-CLAD UO_2 FUEL. Wallace W. Schulz and Gordon L. Hanson (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Mar. 6, 1964. Contract AT(45-1)-1350. 13p.

A total of 34 irradiated PRTR fuel elements were dissolved successfully in the Hanford Redox Plant. A summary is presented of both the plant dissolving experience and the laboratory studies. The dissolution process included the dissolution of the aluminum shipping canisters in NaOH–$NaNO_3$ solution, removal of the Zircaloy cladding and end fittings with NH_4F–NH_4NO_3 solution (Zirflex process), and dissolution of the UO_2 core in HNO_3–$Al(NO_3)_3$ solution. (D.L.C.)

39367 (HW-SA-3672) AN INFORMATION SYSTEM FOR THE PRODUCTION CONTROL OF NUCLEAR MATERIALS IN THE CHEMICAL PROCESSING INDUSTRY (thesis). Lawrence Frederick Wirfs (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). 1964. Contract AT(45-1)-1350. 115p.

Submitted to Univ. of Washington.

A study was conducted to determine and recommend approaches which may be used to develop integrated information systems for the control of nuclear materials in chemical reprocessing plants. The material control procedures and reporting techniques described have application to liquid processing plants in general, and chemical processing plants in particular. The material accounting and production processing systems for nuclear reprocessing plants are described. The effects measurement uncertainties have on the reliability of accounting data were investigated. The use of periodic cleanout inventories to improve inventory reliability and the use of calculated measurement uncertainties as an index of control are recommended and an integrated information system is proposed for the production control of nuclear materials in chemical reprocessing plants. (auth)

39368 (IDO-14641) REPROCESSING OF COATED OMRE FUEL. L. A. Decker and M. E. Jacobson (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). July 1964. Contract AT(10-1)-205. 16p.

As a result of a comprehensive review of earlier work and a laboratory-scale demonstration with irradiated fuel, it is believed that stainless steel clad OMRE fuel coated with degraded terphenyl can be processed satisfactorily without prior cleaning. Either electrolytic dissolution in nitric acid or chemical dissolution in sulfuric acid may be used. The fine particles of coating material present in the dissolver effluent from either process should present no problem in conventional solvent extraction. (auth)

39369 (KR-68) EXTRACTION OF THORIUM AND URANIUM BY MEANS OF TRI-N-OCTYL AMINE. J. M. P. J. Verstegen (Norway. Institutt for Atomenergi, Kjeller). May 1964. 23p.

A study was made of the extraction of thorium (IV) and uranium (VI) from nitric acid medium by means of organic solutions of tri-n-octyl amine. The role of the diluent is emphasized and the tentative conclusion is made that an ideal diluent should have a low dipole moment and a relatively high dielectric constant. The diluent influence, however, is complex and not the same on the extraction of U and Th. It is shown that the separation of U and Th can be improved by a factor 2 by using the proper diluent. The metal complex formation in the benzene solutions of tri-n-octyl amine is discussed. The role of some salting-in and salting-out agents on the dis-

tribution of thorium is studied. The PO_4^{3-} ion has a strong complexing power for Th in the aqueous phase, but the influence of oxalate and citrate is only small. (auth)

39370 (NP-10416) HEADEND PROCESSES FOR URANIUM–MOLYBDENUM ALLOY FUEL. Status Report. E. Lopez-Menchero and Y. Marchant (European Company for the Chemical Processing of Irradiated Fuels, Mol, Belgium). Sept. 23, 1960. 18p. (ETR-89)

Fuel with U–Mo alloy as core material is expected from the EL-2 and EL-3 reactors (10 and 1.35 to 1.6% Mo, respectively). Work was done on development of a dissolution flowsheet for preparation of solvent extraction feed from this fuel. The main features of this flowsheet are a solvent extraction feed 0.6 M in U and 0.76 M in HNO_3; 5 M HNO_3 as the initial reagent; a step for separating the molybdic acid precipitated during dissolution; alkaline dissolution of this Mo followed by HNO_3 dissolution of the U in the precipitate; and the use of this U solution for the adjustment step. (auth)

39371 (NP-10418) DECANNING OF MAGNESIUM-CANNED FUEL BY SULFURIC ACID. Status Report. E. Lopez-Menchero, Y. Marchant, and Ch. de Raikem (European Company for the Chemical Processing of Irradiated Fuels, Mol, Belgium). Aug. 26, 1960. 11p. (ETR-84)

The feasibility of a flowsheet for decanning Mg-canned fuels with sulfuric acid was tested. The main features of this flowsheet are negligible losses of core material in the decanning waste and easy control of the heat release. The advantages over decanning with nitric acid are the elimination of the necessity of critical temperature control in the reacting solution and of the introduction of magnesium nitrate in the solvent extraction feed. (auth)

39372 (NP-11851) STUDY OF THE EXTRACTION OF Pu(IV) NITRATE BY TRILAURYLAMINE. G. Calleri, A. Geoffroy, and J. Arroyo-Suarez (European Company for the Chemical Processing of Irradiated Fuels, Mol, Belgium). Aug. 23, 1961. 34p. (ETR-115)

The possibility of using trilaurylamine (TLA) for the final purification of Pu separated from irradiated fuel is being studied. Values for the distribution coefficient of Pu(IV) nitrate between the aqueous phase and a 0.164-M TLA organic phase are presented. (J.R.D.)

39373 (NP-11916) STRIPPING OF PLUTONIUM FROM AN ORGANIC TRILAURYLAMINE SOLUTION. G. Calleri, A. Geoffroy, and J. Arroyo Suarez (European Company for the Chemical Processing of Irradiated Fuels, Mol, Belgium). Aug. 25, 1961. 21p. (ETR-117)

Test results on stripping of Pu from an organic phase of 0.164 M trilaurylamine in Shell Sol T by different chemical reagents are given. Values obtained for the distribution coefficient of Pu between this organic phase and an aqueous sulfuric acid phase are also presented. (auth)

39374 (NP-12244) I. STUDY OF THE KINETICS OF Pu(IV) ELUTION FROM PERMUTIT SK RESIN, 40-70 MESH, AT 60° BY 0.6 M NITRIC ACID. II. STUDY OF RESIN REGENERATION BY 7.2 M NITRIC ACID. III. CALCULATION FOR A PLUTONIUM PURIFICATION COLUMN OF 40-70 MESH PERMUTIT SK. G. Calleri, A. Geoffroy, F. Franssen, and J. Demonie (European Company for the Chemical Processing of Irradiated Fuels, Mol, Belgium). Sept. 27, 1961. 19p. (ETR-125)

Results of elution tests at 60°C on 40- to 70-mesh Permutit SK resin column loaded with Pu(IV) are presented. The optimum elution rate for highest Pu eluate concentrations in minimum elution time is given. (J.R.D.)

39375 (NP-12246) WASHING BEHAVIOR OF Pu(IV) CHARGE ON A PERMUTIT SK, 40-73 MESH COLUMN. G. Calleri, A. Geoffroy, F. Franssen, and M. Demonie (European Company for the Chemical Processing of Irradiated Fuels, Mol, Belgium). Sept. 13, 1961. 10p. (ETR-123)

Results of Pu(IV)-loaded Permutit SK 40 to 70 mesh resin column washing tests at 60°C are presented. A formula is also included for use in calculation of the amount of Pu that must be loaded on a Permutit SK resin column to prevent Pu loss in the column effluent during washing. (J.R.D.)

39376 (NP-12345) STUDY OF THE KINETICS OF LOADING Pu(IV) ON PERMUTIT SK RESIN FROM 7.2 M NITRIC ACID. G. Calleri, A. Geoffroy, F. Franssen, and M. Demonie (European Company for the Chemical Processing of Irradiated Fuels, Mol, Belgium). Sept. 6, 1961. 48p. (ETR-120)

The possibility of using ion exchange resins for the final purification of Pu separated from irradiated fuel was investigated. The results obtained for Pu loaded on 40 to 70 mesh Permutit SK resin at 60°C from a 7.2 M nitric acid solution and with initial Pu concentrations of 0.8 to 5 g/liter are given. (auth)

39377 (NP-12549) SURVEY OF FUEL DATA. F. Marcus and W. Schueller (European Company for the Chemical Processing of Irradiated Fuels, Mol, Belgium). Apr. 7, 1961. 17p. (ETR-98(Rev.))

Information concerning fuel elements that are expected to be shipped to Eurochemic is presented. Part of the information is based on replies to inquiries while other data are the result of calculations. (J.R.D.)

39378 (NP-12619) THE PHYSICAL CHEMISTRY OF THIRD-PHASE FORMATION. T. Erben (European Company for the Chemical Processing of Irradiated Fuels, Mol, Belgium). Nov. 29, 1961. 12p. (ETR-129)

It is shown that solutions in a pure organic solvent of long-chain amine polynitrates with the same average degree of complexation can be considered as binary systems whose equilibrium state is independent of the presence of the aqueous phase. This makes it possible to apply Van Laar's statistical mechanical treatment of binary mixtures, and to state the conditions in which a new phase can appear. This phenomenon of third-phase formation is characterized by a parameter related to the interchange energy and to temperautre. When this parameter is negative, a new phase can never appear. The new phase appears only when the numerical value of the parameter exceeds 2. An experimental procedure for determining this parameter is suggested, and the conditions that a solvent must satisfy to avoid the possibility of third phase formation are discussed. By measuring experimentally the parameter, it is possible to qualify a solvent and to compare it with others with respect to the tendency to third-phase formation. (auth)

39379 (NP-13396) INVESTIGATION AT KJELLER OF THE DECONTAMINATION FACTORS OF THE EUROCHEMIC FIRST EXTRACTION CYCLE FLOWSHEET. E. Detilleux, E. Lopez-Menchero, and J. Centeno (European Company for the Chemical Processing of Irradiated Fuels, Mol, Belgium). Sept. 1962. 39p. (ETR-141)

An attempt was made to compare the theoretical decontamination factors assumed during the design of the Euro-

chemic flowsheet with the factors determined during Kjeller runs. Gross beta, Ru, Zr/Nb, and Ce are considered. The composition of the Kjeller feed was very similar to the composition assumed for the theoretical "case c" defined in Eurochemic Technical Report (ETR) 78. The gross beta decontamination factor determined at Kjeller for the HA column was approximately 4 times higher than the value assumed for HA + HS in ETR 78. The Ru, Zr/Nb and Ce decontamination factors determined at Kjeller are directly applicable to "case c." The application of the Kjeller decontamination factors for Ru, Zr/Nb and Ce to the HA column when processing a fuel defined as "case a" in ETR 78, showed that the gross beta decontamination factor to be attained in column HS in order to achieve the theoretical value used in ETR 78 for HA + HS is only 7. The effect, on the decontamination, of some parameters applied during the Kjeller runs is described. (auth)

39380 (ORNL-3660) HOT-CELL STUDIES OF AQUEOUS DISSOLUTION PROCESSES FOR IRRADIATED CARBIDE REACTOR FUELS. J. R. Flanary, J. H. Goode, M. J. Bradley, J. W. Ullmann, L. M. Ferris, and G. C. Wall (Oak Ridge National Lab., Tenn.). Sept. 1964. Contract W-7405-eng-26. 38p.

Three head-end processes for recovering uranium and plutonium from uranium and plutonium carbide reactor fuels were investigated using specimens irradiated to burnups of up to 20,000 Mwd/metric ton. Solvent extraction behavior of the fuel solutions produced was examined in batch shakeout tests. Reaction with steam (pyrohydrolysis) at 750°C was the best method tested, although direct dissolution in boiling 13 M (60%) HNO_3 followed by oxidation of residual organic impurities in the resulting solution is also potentially useful. Hydrolysis with liquid water at 80 to 100°C is not feasible since the irradiated carbides of uranium and plutonium are passive. During pyrohydrolysis at 750°C (air excluded), the uranium monocarbide was converted to UO_2, containing only about 0.03% C. The gaseous reaction products were H_2, CO_2, and CO. Cesium was the principal fission product volatilized, but the amount was very low (0.5%). This cesium was trapped when the excess steam was condensed. The UO_2 product readily dissolved in 6.5 M HNO_3 to yield a solution suitable as a feed for Purex solvent extraction. Batch solvent extraction tests showed that greater than 99.9% of the uranium and plutonium could be recovered and separated from gross fission products by a factor of 10^4. The pyrohydrolysis process was also successfully demonstrated with irradiated 20% PuC—80% UC specimens. Irradiated uranium monocarbide or the mixed uranium–plutonium carbide could be dissolved directly in 60% HNO_3, but about 44% of the carbide carbon remained in solution, primarily as organic acids that interfered with solvent extraction. The organic impurities were largely eliminated by oxidative degradation. In solvent extraction tests of the treated solutions, recovery was nearly quantitative, but up to 0.4% of the plutonium was retained by the solvent after stripping. The plutonium retention was attributed to residual organic impurities. Uranium and plutonium were separated from gross fission products by a factor of 3.4×10^4. (auth)

39381 (RT/CHI(63)-30) TRASFERIMENTO DI UN SOLUTO ALL'INTERFASE DI UN SISTEMA LIQUIDO-LIQUIDO. (Transfer of the Solution Interface in a Liquid-Liquid System). P. R. Danesi, F. Orlandini, and G. Scibona (Italy. Comitato Nazionale per l'Energia Nucleare, Rome). Oct. 1963. 23p.

The transfer kinetic of the $UO_2(NO_3)_2$ in the system $UO_2(NO_3)_2$, H_2O, NO_3^--Alamina 336 Solvesso was determined in the dynamic state. The influence of the concentration of the amine, HNO_3, $Al(NO_3)_3$, $UO_2(NO_3)_2$, on the transfer constant was studied. (auth)

39382 NEW APPROACH TO SEPARATION OF TRIVALENT ACTINIDE ELEMENTS FROM LANTHANIDE ELEMENTS. SELECTIVE LIQUID-LIQUID EXTRACTION WITH TRICAPRYLMETHYLAMMONIUM THIOCYANATE. Fletcher L. Moore (Oak Ridge National Lab., Tenn.). Anal. Chem., 36: 2158-62(Oct. 1964). (ORNL-P-37)

Preferential liquid-liquid extraction of the anionic thiocyanate complexes of trivalent actinide elements with tricaprylmethylammonium thiocyanate dissolved in xylene or other solvents affords an improved method for their separation from the lanthanide elements. The order of decreasing extractability in californium > berkelium > americium, curium ≫ ytterbium > thulium > europium > promethium > yttrium > cerium > lanthanum. Various dilute acids enhance the separation factors markedly. Among the advantages of this method are the high single stage separation factors possible and the elimination of neutron hazard and corrosion problems associated with lithium chloride-hydrochloric acid systems. Several useful analytical and process applications of the method are discussed. (auth)

39383 SEPARATION OF LABELED COMPOUNDS USING GAS CHROMATOGRAPHY. S. A. Volkov and K. I. Sakodynskii. At. Energ. (USSR), 17: 70-1(July 1964). (In Russian)

The separation of deuterated methylethoxysilanes, obtained in a Grignard reaction from tetraethoxysilane and deuterium bromide was carried out. The analysis of the reacted mixture, performed on the Griffin analytical chromatograph using the stationary phase of silicone oil, showed the presence of trimethylethoxysilane, dimethyldiethoxysilane, methyltriethoxysilane, the unreacted tetraethoxysilane, and a large quantity of ether. Dimethyldiethoxysilane and trimethylethoxysilane tagged with deuterium were separated chromatographically in the quantity of several grams. Experiments on model systems showed that for temperatures of about 100°C compounds with boiling points to 160 or 170°C can be separated from a mixture. (M.J.T.)

39384 SEPARATION OF PHOSPHORIC ACID WITH THORIUM NITRATE. Motosuke Furuya and Masatoshi Tajiri (Kiyomine Kinzoku Kogyo Co., Ltd., Tokyo). Bunseki Kagaku, 12: 1139-44(1963). (In Japanese)

The precipitation of phosphoric acid with thorium ion was applied to the separation of phosphoric acid. A sample solution containing phosphoric acid is treated with 20 ml of nitric acid-hydrochloric acid mixture (1 + 1 + 2), and diluted to 50 ml with water. About 20 ml of 50% ammonium acetate is added for adjusting the pH of the solution to 2.0 to 3.5. It is then treated with 1.5 to 3 ml of M/50 thorium nitrate solution against 1 mg P and boiled for about 3 min to complete the precipitation. It is cooled and the precipitate filtered and washed with 1% ammonium acetate solution. In the recovery of the phosphoric acid precipitate a small amount of thorium is absorbed and thus this method could not be used for the gravimetric determination of phosphorus. The method is suitable for removing phosphoric acid in the determination of magnesium and calcium by EDTA titration and for separation of a large amount of phosphoric acid from copper, nickel, and zinc. (auth)

39385 APPLICATION OF FUSED-SALT FLUORIDE-VOLATILITY PROCESSING TO VARIOUS REACTOR FUELS. G. I. Cathers, M. R. Bennett, and R. L. Jolley (Oak Ridge National Lab., Tenn.). Chem. Eng. Progr., Symp. Ser., 60: 31-6(1964).

Laboratory-scale studies on the feasibility of hydrofluorination, in a molten fluoride medium, of reactor fuels containing stainless steel and various oxides such as uranium dioxide, thorium dioxide, beryllium oxide, and zirconium dioxide, followed by fluorination of the uranium and volatilization of the uranium hexafluoride are reported. Pilot plant processing of enriched uranium–zirconium fuel by this method is now being undertaken following laboratory-scale demonstration, with highly irradiated fuel, of good uranium recovery and decontamination. Hydrofluorination in lithium fluoride-sodium fluoride–zirconium tetrafluoride gave good dissolution rates for the various fuel components mentioned above. Other salt systems were studied with favorable results, for example, the sodium fluoride–lithium fluoride–beryllium fluoride system as the hydrofluorination medium for beryllium oxide. Corrosion rates, product fluoride solubility or volatility, and the recovery of uranium by subsequent fluorination were investigated. The kinetics of fluorination of uranium from hydrofluorination salts was studied to show the importance of melt temperature. The fluorination of plutonium from fused salts as plutonium hexafluoride was studied at low concentrations. The favorable plutonium test results indicate that a fused-salt-volatility process might be applied to low-enrichment power-reactor fuels. (auth)

39386 CHLORIDE VOLATILITY PROCESSING OF NUCLEAR FUELS. T. A. Gens (Oak Ridge National Lab., Tenn.). Chem. Eng. Progr., Symp. Ser., 60: 37-47(1964).

Chloride volatilization (Zircex and oxyhydrochlorination) processes were developed in laboratory studies for processing nuclear reactor fuels. The major objective is separation of the bulk of the structural material by volatilization from the fertile and fissile material and recovery of the latter in a form readily introducible into the next step in the processing cycle. Other objectives are low corrosion rates through the use of gas-solid reactions with cooled walls and simplified storage or disposal of waste. In the Zircex process, uranium alloy fuels containing any combination of zirconium, niobium, aluminum, and hydrogen are hydrochlorinated at fuel-element temperatures of 300 to 800°C. The chlorides of zirconium, niobium, and aluminum are volatilized at reactor wall temperatures in the range 200 to 300°C. The residue, containing uranium trichloride and oxide impurities, is converted to volatile chlorides by reaction with carbon tetrachloride vapor at 500°C, and uranium chloride is quantitatively recovered from the off-gas by fractional condensation at 300°C, at which temperature all other products are volatile. The uranium chloride product may be dissolved in nitric acid and the chloride removed by distillation (Darex process) in preparation for solvent extraction or fluorinated to volatile uranium hexafluoride. In the oxyhydrochlorination process, uranium–molybdenum alloys are treated with a 15% hydrogen chloride–air mixture at 400°C to produce volatile molybdenum oxychloride and nonvolatile uranium and plutonium oxides. The oxides are dissolved in nitric acid for decontamination and recovery by solvent extraction. (auth)

39387 URANIUM–ZIRCONIUM ALLOY FUEL PROCESSING IN THE OAK RIDGE NATIONAL LABORATORY VOLATILITY PILOT PLANT. W. H. Carr, S. Mann, and E. C. Moncrief (Oak Ridge National Lab., Tenn.). Chem. Eng. Progr., Symp. Ser., 60: 56-61(1964).

The volatility pilot plant is currently engaged in a development program on zirconium–uranium alloy fuel processing. Fourteen dissolution runs have been made at 650 to 500°C in a molten salt of equimolar sodium fluoride–lithium fluoride containing 25 mole % zirconium fluoride. Seven runs have been carried, through the fluorination phase at 500°C with the uranium hexafluoride product being sorbed on and desorbed from sodium fluoride and collected in a cold trap. Overall fuel dissolution rates of 3.68 kg/hr were obtained with hydrogen fluoride utilizations of 30–45%. Uranium losses/run were <0.31% of the uranium feed. Chemical contaminants in the uranium product were primarily sodium, molybdenum, and copper. The principal process operating difficulty has been off-gas valve plugging due to sub-micron size particles generated during the dissolution reaction. (auth)

39388 PAPER CHROMATOGRAPHIC SEPARATION OF TITANIUM, THORIUM AND CERIUM OR ZIRCONIUM, THORIUM AND CERIUM. D. R. Singh and G. C. Saxena (Agra Univ., India). Current Sci. (India), 33: 430-1(July 20, 1964).

Tests were made of the possibility of using simple inorganic solvents in paper chromatography of inorganic cations using the following solvents: HCl, HNO_3, H_2SO_4, NaOH, NH_3OH, Na_2CO_3, NaCl, $NaNO_3$, Na_2SO_4, and salt and alkali mixtures. Compounds of zirconium, thorium, titanium, and cerium were used in the test solution. All except sodium carbonate were found to be unsatisfactory. (M.C.G.)

39389 PIERRELATTE. THE CHEMICAL PLANTS. PREPARATION OF URANIUM HEXAFLUORIDE. A. Level. Energie Nucl., 6: 225-32(June 1964). (In French)

The description of the uranium hexafluoride manufacturing plant at the Pierrelatte chemical plant is preceded by a review of the properties and the various preparation methods of the product. Some indications are also given on the plants' operation and the results that were obtained during the first months of operation. Finally, the special security arrangements, due to the toxicity of the products that are handled, are also described. (auth)

39390 EFFECT OF ULTRASONIC VIBRATIONS UPON THE EXTRACTION OF SPARINGLY SOLUBLE RARE-METAL COMPOUNDS. N. N. Khavskii. Izv. Vysshikh Uchebn. Zavedenii, Tsvetn. Met., No. 3, 106-10(1963).

The importance of more efficient leaching processes for lean ores of nonferrous and less-common metals is discussed. Studies were made on the effect of ultrasonic vibrations of certain frequencies and intensities on accelerated carbonate leaching of certain sparingly solubie substances, with special reference to the effect of temperature, rate of stirring and amount of catalyst (a copper–ammonium complex) on the degree of extraction of metal from the compound in an ultrasonic field. The effects of temperature and duration of treatment at various stirring speeds in the presence of absence of ultrasound were included. (TCO)

39391 SORPTION OF STRONTIUM-90 BY SOIL. Hwa-sheng Cheng (Tsing Hua Univ., Hsinchu, China). J. Chinese Chem. Soc. (Taiwan), 11: 24-9(May 31, 1964).

The removal of ^{90}Sr by various clay deposits at pH values ranging from 0 to 14 was found to be slightly less effective than radiocesium uptake. The radiostrontium uptake by red and yellow soil was greatly affected by the foreign cations (0.01N). Yellow soil was particularly suited for the removal of ^{90}Sr. (auth)

39392 SORPTION OF RADIOEUROPIUM BY SOIL. Hwa-sheng Cheng (Tsing Hua Univ., Hsinchu, China). J. Chinese Chem. Soc. (Taiwan), 11: 50-5(May 31, 1964).

The removal of radioeuropium (^{152}Eu, ^{154}Eu) was practically complete at pH values greater than 4 by seven clay deposits that were studied. The chemical properties of the radioeuropium rather than the nature of the sorbing matrices were the determining factors in its decontamination. The effects of competition toward radioeuropium uptake from solutions by, and extraction of sorbed radioeuropium from, yellow and red soil by various cations (0.01N) were studied. (auth)

39393 PRODUCTION OF SHORT-LIVED URANIUM FISSION PRODUCTS. R. Muenze, H. Hladik, and G. Wagner (Zentralinstitut für Kernforschung, Rossendorf, Ger.). Kernenergie, 7: 502-4(June-July 1964).

Methods are described for the isolation of uranium fission products with half lives in the 10-hr to 100-day range and that are suitable for the production of ^{132}Te, ^{132}I, ^{131}I, ^{140}Ba, ^{140}La, ^{89}Sr, ^{95}Zr, ^{95}Nb, ^{133}Xe, and various radioactive rare earth nucleids. After obtaining gaseous tellurium isotopes (H_2Te) and ^{133}Xe by means of separation, the various components contained in the fission solution are separated by chromatography in a cationic compound-filled column. (auth)

39394 DESALINIZATION OF WATER. Power Reactor Technol., 7: No. 2, 138-44(Spring 1964).

The design, development, economic aspects, and use of nuclear reactors for desalinization of sea water are reviewed. Results are summarized on reactor types used in studies of nine different electric generation-desalinization cases. (N.W.R.)

39395 BEHAVIORS OF Sn, Ti AND Fe IN LIQUID-LIQUID EXTRACTION OF Nb AND Ta. Sanji Nishimura (Kyoto Univ.), Jyoichiro Moriyama, and Isao Kushima. Trans. Japan Inst. Metals, 5: 32-8(Jan. 1964).

Behavior of the impurities, Sn, Ti, and Fe in liquid–liquid solvent extraction of Ta and Nb with organic solvents was investigated in four solvent extraction systems: HF-hexone, HF-HCl-hexone, HF-H_2SO_4-hexone, and HF-HNO_3-hexone systems. By measuring the distribution ratios of Sn, Ti, Fe, Ta, and Nb in each extractive system, it was found that Sn, Ti, and Fe can be separated sufficiently from Nb and Ta. The extractabilities of Sn, Ti, and Fe increased with the mineral acid concentration at a constant HF acidity. At a constant high HF acidity, 12.75 N, they decreased in the following order: HF-HCl system > HF-H_2SO_4 system > HF-HNO_3 system. The separation of Sn, Ti, and Fe from Ta was easier than from Nb. In the HF-mineral acid-hexone system an extract of higher purity than that in the HF-hexone system could be obtained by selecting some suitable mineral acid concentrations and by utilizing an advantage of larger coextractability of Nb and Ta. (auth)

39396 EXTRACTION AND SEPARATION OF TANTALUM AND NIOBIUM BY LIQUID-LIQUID EXTRACTION IN THE HF–H_2SO_4–TBP SYSTEM. Sanji Nishimura (Kyoto Univ.), Jyoichiro Moriyama, and Isao Kushima. Trans. Japan Inst. Metals, 5: 39-42(Jan. 1964).

The method for extracting and separating Ta and Na by using the solvent extraction system, HF–H_2SO_4–TBP, was investigated. The extractability of fluotantalates and fluoniobiates from HF–H_2SO_4 solution into TBP was found to be functions of HF acidity, H_2SO_4 acidity, TBP concentration, oxide concentration, organic solvent ratio, and extraction frequency. The percentage of Te extracted and the Ta distribution ratio increased with an increase in H_2SO_4 acidity at a constant HF acidity, but decreased with increasing HF acidity at a constant H_2SO_4 acidity. They diminished with the decrease of TBP concentration. The percentage of Nb extracted and the Nb distribution ratio increased with increasing HF acidity, H_2SO_4 acidity, and TBP concentration. In general, the separation coefficient was superior in low HF acidity–low H_2SO_4 acidity. It was changed little by varying TBP concentrations. The percentage of Ta and Nb extracted fell with an increase in oxide concentration in the aqueous solution. The increasing volume ratio of solvents and the frequency of extraction caused increases of the percentage extractions of Ta and Nb. The extract obtained with TBP contained little impurities. The HF–H_2SO_4–TBP system had higher extractability of Ta and Nb, particularly Nb, and was higher in purity of the organic extract than the HF–H_2SO_4–hexone system. (auth)

39397 SELECTION OF COMPLEXING SUBSTANCES FOR PAPER CHROMATOGRAPHIC SEPARATION OF RARE EARTHS. THE USE OF TRICHLOROACETIC ACID. G. M. Varshal and M. M. Senyavin (Vernadskii Inst. of Geochemistry and Analytical Chemistry, Moscow). Zh. Analit. Khim., 19: 947-54(1964). (In Russian)

Principal characteristics of a complexing substance used for the chromatographic separation of a mixture of rare earths, which, together with the NO_3^- ion, forms a part of the inner coordination sphere of rare earth ions are described. Polybasic carboxylic acids and hydroxy acids can not be used for chromatographic separation in a nitrate system due to their high hydrophilic properties and high stability of their complexes with rare earths. Monobasic carboxylic acids, and particularly their halogen derivatives with high hydrophobic properties can be successfully used as complexing substances for the chromatographic separation of rare earths on paper in a nitrate system. Trichloroacetic acid was suggested as one of such complexing substances. Trichloroacetic acid permits the quantitative separation of the elements of the cerium group: La, Ce, Pr, Nd, Sm, Gd, and Tb. Yttrium has a common zone with dysprosium; holmium with erbium, and thulium with ytterbium and lutetium. (auth)

39398 CHEMICAL PROCESSING IN THE ATOMIC ENERGY INDUSTRY. A. R. Cooper. London, Iliffe Books Ltd., 1964. 169p. 38s 6d.

Techniques for processing reactor materials are reviewed; and the extraction and properties of Pu, U, Th, Zr, Be, Nb, and graphite are described individually. Methods for reprocessing several kinds of fuels are also considered, together with isotope separation techniques and techniques for production of D_2O and enriched U. (D.C.W.)

39399 MINIATURE CENTRIFUGAL CONTACTOR (Engineering Materials). (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). (CAPE-1078)

Drawings (15) are presented for the 16-stage contactor which is suitable for remote operation with highly radioactive materials. Housing is of stainless steel, and the stages are arranged in a circular configuration which allows a central gear drive for all of the bowls and a gear train drive for all mixers. Individual bowls and mixers are replaced by lifting out a single assembly. Thus it may be changed into a smaller unit or it can be split into two 7-stage units by replacing a mixer with a plug to allow withdrawal of the endstream. Each stage has an

auxiliary feed inlet and provision for sampling both phases. In the prototype, the bowl section and drive shaft were separated. In this piece of equipment these two pieces were combined to improve fabrication technique and to increase strength. For a listing of individual titles, see the Engineering Materials List (TID-4100). (C.E.S.

39400 CONVERSION OF THE TUBA CITY MILL FROM ACID LEACH RIP PLANT TO AN ALKALINE LEACH FILTRATION PLANT. D. R. Lewis and S. M. Runke. 22p. (CONF-656-1)

From 9th Annual Minerals Symposium, Moab, Utah, May 1964.

The Tuba City Mill was designed and built to process the uranium ores produced in the Cameron Mining District by acid leaching and the resin-in-pulp or R.I.P. process. As it became apparent that the Orphan Lode Mine would become the principal source of ore for the Tuba City Mill, it also became apparent that a change in the method of processing would be required. The Orphan Lode ore was considerably higher in lime content than other ores being processed, and as the mine was developed to greater depths, it was found that the average lime content of the ore rose to a point where it no longer would be economical to process it by acid leaching. However, investigations showed that the ore was amenable to leaching with sodium carbonate solution, precipitation of uranium with sodium hydroxide, and regeneration of the sodium carbonate in the barren solution with CO_2 gas. Flowsheets are given for: ore receiving and crushing; grinding, flotation, and thickening; carbonate leaching and filtering; clarification, precipitation, and packaging; acid leach and uranium recover; and solvent extraction. (P.C.H.)

ENGINEERING

General

Refer also to abstract 40824.

39401 (AD-600564) EFFECTIVENESS OF A GRID IN A BLAST SIMULATOR. V. H. Crow (Naval Civil Engineering Lab., Port Hueneme, Calif.). [196?]. 18p. (TN-561)

Test results are presented which demonstrate the effectiveness of a layered grid in increasing the duration of the loading in the NCEL blast simulator. The tests were performed to check the hypothesis that long-duration loads could be obtained in a semi-closed load generation system without developing objectionable reflected pressures. This information was needed to check out a principle of operation for a proposed traveling wave blast simulator. The data demonstrate that it is possible to materially increase the duration for a given energy expenditure and simultaneously prevent the formation of large reflected pressure waves. (auth)

39402 (ANL-6882) BENDING OF CIRCULAR PLATES UNDER A VARIABLE SYMMETRICAL LOAD. J. C. Heap (Argonne National Lab., Ill.). Apr. 1964. Contract W-31-109-eng-38. 30p.

The basic equations of deflection, slope, and moment for a thin, flat, circular plate, under a symmetrical variable load, for a constant force divided by the square of the radial distance, have been developed. Six cases have been derived. The first four cases cover the variable load acting over the entire plate, viz., (1) fixed, supported, outer edge and fixed, inner edge, (2) simply supported, outer edge and free, inner edge, (3) simply supported, outer edge and fixed, inner edge, (4) fixed, supported, outer edge and free, inner edge; and the final two cases are for a solid plate having the acting variable load bounded by circles of an inner radius and the outer support-load radius; i.e., (5) fixed, supported, outer edge, and (6) simply supported, outer edge. (auth)

39403 (BRL-1231) RESPONSE OF SUBMERGED SPHERICAL SHELLS TO INTERNAL BLAST LOADING. W. E. Baker, J. W. Hanna, and J. D. Patterson (Ballistic Research Labs., Aberdeen Proving Ground, Md.). Dec. 1963. 23p.

The results of experiments on the response of thin spherical shells submerged in water to blast from internal explosive charges are presented. The results are compared with theory. Results of measurements of the underwater shock transmitted from the shells into the surrounding water are also reported and these shock intensities are compared with direct underwater shocks. (auth)

39404 (NAA-SR-9762) STRESS AND ELEVATED TEMPERATURE FATIGUE CHARACTERISTICS OF LARGE BELLOWS. R. A. Winborne (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Sept. 15, 1964. Contract AT(11-1)-Gen-8. 84p.

Ten large 20-in. diameter 304 stainless steel bellows were tested to or near fatigue failure; nine in 1200°F sodium, and one in air at 70°F. The data indicated that, at 1200°F, fatigue life of axially deflected large convolute-shaped bellows, without internal pressure influence, was mainly determined by bellows geometry, and was associated with a factor μ, used frequently in asymptotic shell theory of convolute-shaped bellows, where: $\mu = [a^2\sqrt{12(1-\nu^2)}/\overline{R}t]$; a = bellows convolution radius, $\overline{R}$ = average bellows radius, t = bellows wall thickness, and ν = Poisson's ratio. On a log-log chart, there appeared to be a linear relationship between $1/\mu$ and cycles-to-failure of axially deflected, large convolute-shaped bellows at 1200°F. The fatigue life of a bellows with a high-μ value ($\mu = 6$) was less than $^1/_{100}$ that of a bellows with low-μ value ($\mu = 0.25$). Conventional high-μ ($\mu \gtrsim 2$) bellows always failed at, or near, the welded junctures of the bellows-to-pipe ends where stresses were highest. With stresses very uniformly distributed over their profiles, low-μ ($\mu = 0.25$) bellows appeared to be relatively insensitive to stress raising influences. The fatigue test performance of one toroid-shaped bellows was excellent. Charts show axial stress distribution over exterior bellows surfaces induced by bellows axial deflection, and by internal pressurization. The influence of root rings on stress distribution is presented graphically. (auth)

39405 (PNE-501P) STEM DESIGN. Kenneth L. Saucier (Waterways Experiment Station, Vicksburg, Miss.). Aug. 1964. Project PRE-SCHOONER. 37p.

The access holes of Project PRE-SCHOONER, a cratering experiment using chemical explosives, has to be stemmed with a material which will react in the same manner as the in situ medium (basalt rock) when the detonation occurs. Stem designs using concrete and keys were developed to match as closely as possible the structural properties of basalt. (D.L.C.)

39406 (RT/ING(64)7) RILIEVI ACCELEROMETRICI A BORDO DI GRANDI NAVI (T/C "ERCOLE" DELLA FLOTTA LAURO). (Acceleration Surveys on Board Big Ships (T/C "Ercole" of the Laurel Fleet)). F. Spinelli, E. Fasano, S. Roccotelli, and A. De Vito (Naples. Universita. Istituto Costruzioni Navali). May 1964. 52p.

The equipment and the measuring instruments adopted are described; the research carried out is illustrated, with the results obtained and their analytical elaboration. From the first surveys it is evident that the value of the resultant accelerations on board big ships is very moderate. Since the shock accelerations measured in the collision experiment carried out by the Marine Engineering Institute of Naples University are also small, it seems possible to foresee that the total acceleration to be considered for the evaluation of inertial forces acting upon the parts of the ship sides containing nuclear equipment will not be greater than 0.5 g. (auth)

39407 (TID-4100(Suppl.22)) SUPPLEMENTAL INSERT SHEETS FOR ENGINEERING MATERIALS LIST. Richard E. C. Duthie, ed. (Division of Technical Information Extension, AEC). Aug. 1964. 84p.

Lists are presented under computers, engineering equipment, hot laboratory equipment, instruments, metallurgical equipment and processes, radiation instruments, reactors and reactor facilities, accelerators, plant design and processes, radiation equipment, rockets and missiles, and specifications. (D.L.C.)

39408 (JPRS-26001(p.11-24)) ADHESIVE "PED-B" FOR CEMENTING PLASTICS OF FORMULA 57-40 TO THE SURFACES OF CONSTRUCTION UNITS. G. V. Struminskii, T. A. Ignatova, T. G. Ivanova, T. N. Katkova, and A. S. Zelenov. Translated from p.80-92 of "Zashchitnye Pokrytiya v Atomnoii Tekhnike," Moscow, 1963.

Glue PED-B was developed for cementing 57-40 vinyl blends to concrete, metals, etc., as protective coatings against radioactive contamination. The glue comprises 15 parts perchlorvinyl resin, 13 parts epoxide resin ED-5, 90 parts methylene chloride, and 10 parts cyclohexanone. Glued joints are protected by deactivatable lacquers and retain the necessary strength after a gamma dose of 100 Mrad. Methods for gluing the plastics to wall surfaces are described. (D.L.C.)

Applications of Nuclear Explosions

Refer also to abstracts 40427 and 40431.

39409 EFFECTS OF NUCLEAR EXPLOSIONS ON OIL RESERVOIR STIMULATION. H. F. Coffer (Continental Oil Co., Ponca City, Okla.), B. G. Bray, C. F. Knutson, and D. E. Rawson. J. Petrol. Tech., 16: 473-80(May 1964).

A general description of Project Plowshare's Gnome atomic explosion near Carlsbad, N. M., is given from the point of view of possible application to oil reservoir stimulation. Post-shot exploratory mining and drilling into the explosion environment and blast cavity are discussed. Petroleum reservoir core and crude oil samples placed near the explosion were subjected to shock energy, high pressures, and radiation from the atomic blast. These samples were recovered, analyzed, and compared with unexposed, duplicate samples. Additional investigations, which must be undertaken to resolve problems that will be encountered in the use of an atomic device in an oil reservoir, are discussed. (auth)

Facilities and Equipment

Refer also to abstracts 39333 and 40092.

39410 (APCI-541102) ENERGY DEPOT CRYOGENIC FUEL STORAGE AND DISTRIBUTION SYSTEM. PHASE I—CONCEPTUAL DESIGN STUDY. Quarterly Progress Report No. 2, July–September 1963. R. G. Clark, E. M. Flounders, and P. D. Stelts (Air Products and Chemicals, Inc., Allentown, Penna.). Oct. 1963. Contract AT(30-1)-3129. 41p.

Sufficient vendor and materials information was collected to allow the procurement of the outer shell aluminum-honeycomb cylindrical section, the outer shell cylinder heads, the inner shell for the light-weight 50-gallon test vessel, and the multiple radiation shield insulation for the boiler-plate and light-weight 50-gallon test vessels. Tests to identify a satisfactory aluminum-to-steel welding transition piece and tests to permit the future selection of the most promising of the candidate inner vessel materials are progressing. The boiler-plate 50-gallon test vessel was designed and is being fabricated. The fabrication of the instrumented test stand is nearing completion. The testing program is established. The preliminary design of the light-weight 50-gallon test vessel has progressed to the point that the inner and outer shell materials are being ordered. (auth)

39411 (APCI-541103) ENERGY DEPOT CRYOGENIC FUEL STORAGE AND DISTRIBUTION SYSTEM. PHASE I—CONCEPTUAL DESIGN STUDY. Quarterly Progress Report No. 3, October–December 1963. R. G. Clark, A. Karalis, H. Rowles, and P. D. Stelts (Air Products and Chemicals, Inc., Allentown, Penna.). Jan. 1964. Contract AT(30-1)-3129. 71p.

Welding procedures were established and physical testing of weldments is nearing completion for the series of high strength steel and aluminum alloys considered to be promising for lightweight liquid hydrogen vessels. The boiler-plate 50 gal test vessel was fabricated and developmental testing is nearing completion. The design of the lightweight vessel is completed. The conceptual design of the integrated fuel storage and distribution system was established. (auth)

39412 (IDO-14607) REMOVAL OF PARTICULATES FROM WASTE CALCINING FACILITY OFF-GAS. R. D. Modrow and L. T. Lakey (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). June 1964. Contract AT(10-1)-205. 26p.

In testing prior to radioactive operation of the ICPP Waste Calcining Facility, the overall particulate decontamination factor for the off-gas cleanup system, consisting of a cyclone, a quench tower, a venturi-scrubber and its associated de-entrainment cyclone, silica gel beds, and off-gas filters, was determined to be at least 3.6×10^5. The cleaned off-gas contained not over 5×10^{-6} grains/acf of particulate solids which were essentially spherical and less than 0.1 μ in diameter. Descriptions of the cleanup equipment and the special techniques, i.e., gas sampling, radiotracer, and sample activation, used to obtain data on the rate of flow of solids at various points in the system are included. These data were used to determine the decontamination factor for each of the various pieces of equipment. Subsequent sampling during operation with actual high-level radioactive waste confirmed the test results on all but the off-gas filters which had a higher than expected decontamination factor. The overall decontamination factor for the off-gas cleaning system during the initial two months of radioactive operation of the WCF was higher than that measured in the nonradioactive tests by a factor of ten or more. (auth)

39413 (ORNL-TM-932) STUDY REPORT: SHIELDED VIEWING WINDOWS AND ALPHA SEAL WINDOW ASSEMBLIES FOR TUFCDF. A. E. Spaller (Oak Ridge National Lab., Tenn.). Aug. 25, 1964. Contract W-7405-eng-26. 30p.

Several window designs were studied to provide recommendations for the type and size of shielded viewing windows to be used in the Th-U Fuel Cycle Development Facility hot cells. Maximum viewing angles, light transmittance, and estimated cost were determined for each window design. Maintenance, radiation damage, and hazards involved for the various types of construction and shielding media were studied. A conceptual design for an alpha seal window assembly was developed. Conclusions and recommendations are included. (auth)

39414 (TID-3578) FIRE AND EXPLOSION PROTECTION OF GLOVE BOX FACILITIES. A Literature Search. Sidney F. Lanier, comp. (Division of Technical Information Extension, AEC). Aug. 1964. 60p.

A total of 379 annotated references is cited on the safety design of facilities handling radioactive materials. Included are references on glove boxes, fire hazards and

control, explosion hazards and control, laboratory design, ventilation systems, and filter systems. (auth)

39415 THE DESIGN AND THE WORK FLOW IN AN EXPERIMENTAL RADIOLOGICAL LABORATORY. A. S. Srapionov (Lab. of Radiation Safety, USSR). p.136-42 of "Radiatsionnye Effekty v Biologicheskikh Sredakh i Organizmakh i Metody ikh Issledovaniya." Tashkent, Publishing House of the Sciences, 1964. (In Russian)

Descriptions are given of the design and organization of a radiological laboratory. The room arrangement, installation of equipment, and isotope storage are discussed, as well as sanitation and safety measures. (R.V.J.)

39416 ORINS MEDICAL IRRADIATION FACILITY (Engineering Materials). (Oak Ridge Inst. of Nuclear Studies, Inc., Tenn.). (CAPE-1123)

Nineteen drawings are included that describe several irradiation rooms including shielding. The facilities discussed include: the radiation storage vault, which contains 256 compartments for the storage of small quantities of radioactive materials; the telecobalt therapy building addition, which consists of a treatment room 14 ft × 24 ft and a control room 14 ft × 8 ft 7⅝ in.; and the total body irradiator room, which contains 8 cesium-137 sources. The facility is constructed of poured concrete. (P.C.H.)

39417 HOT AIR CONTROL VALVE FOR THE 18 IN. HYPERSONIC WIND TUNNEL, SNAD-51(Engineering Materials). (Sandia Corp., Albuquerque, N. Mex.). (CAPE-1086)

Drawings (19) describe the modifications of the hot air valve used in the 18 in. hypersonic wind tunnel. This paralleled seating, gate valve with seating on the downstream face only is employed to close off the heat combustion chamber from the tunnel circuit during the heating period, seals off the high pressure hot air in the heater from the evacuated tunnel circuitry during the heat prepressurizing cycle, and provides rapid opening and closing to control the blowdown cycle. An unusual metal-to-metal seal is employed. For a listing of individual titles, see the Engineering Materials List (TID-4100). (C.E.S.)

39418 NASA SPACE PROPULSION FACILITY. W. J. Dodson (Kaiser Engineers, Oakland, Calif.). 9p. (CONF-446-16)

From American Nuclear Society 10th Annual Meeting, Philadelphia, June 1964.

A space-simulation facility is described that is capable of testing a full-sized space vehicle propelled by a nuclear-reactor-powered ion engine. (T.F.H.)

39419 ELECTRIC POWER SYSTEMS FOR A LARGE MANNED ORBITAL SPACE STATION. Philip Frankel (Lockheed-California Co., Burbank). 43p. (CONF-637-5)

From Institute of Electrical and Electronics Engineers Region 3 Annual Meeting and Technical Conference, Clearwater, Fla., May 1964.

The development status of power systems in the 10- to 40-kev range for a large manned orbital space station with a one- to five-year mission is assessed. The following systems were studied in depth: a solar photovoltaic system using n/p Si solar cells and Ag–Cd batteries for energy storage; a solar dynamic system using thermal energy storage and Rankine, Stirling, and Brayton cycle engines; a nuclear dynamic system using a reactor heat source and either Rankine or Brayton cycle engines; a radioisotope heat source and Brayton cycle conversion system. Redundant components necessary to assure a minimum 0.95 level of reliability were incorporated into each system. The systems were compared and evaluated on the basis of weight, cost, availability, logistic requirements, and influence on station design and operation. It is concluded that the reliability goals can be achieved with highest confidence with the solar photovoltaic power system. The solar dynamic and radioisotope dynamic systems are superior from a weight standpoint. The solar photovoltaic system was selected as the earliest available system that could meet the stated requirements. (A.G.W.)

39420 SOLAR ABSORPTIVITY MEASUREMENT AND ULTRAVIOLET IRRADIATION IN A SPACE ENVIRONMENT. D. Horwitz and D. V. McIntyre (Hughes Aircraft Co., Culver City, Calif.). 8p. (CONF-622-3)

From Institute of Environmental Sciences 1964 Technical Meeting, Philadelphia, Apr. 1964.

A combination high-vacuum integrating sphere and irradiation chamber designed to accomplish both solar absorptivity measurements and ultraviolet irradiation within a simulated space environment is described. The structural members are made of 300-series stainless steel and dense alumina ceramic. All optical ports into the sphere and chamber are lenses and windows ground from quartz. A sorption pump is used for roughing and ion pumps are used for final pumping. All motions into the system are transmitted by stainless steel welded diaphragm bellows. Either coolant or a heated fluid may be pumped through the sample holders at a high flow rate. Measurements of spectral energy from 0.25 to 2.7 μ are made in 2% energy increments of the Johnson curve, and an integrated value of solar absorptivity is calculated for each material. (A.G.W.)

39421 A HIGH INTENSITY MERCURY ION SOURCE OF DUOPLASMATRON TYPE. A. Septier, F. Prangere, and H. Ismail (Faculte des Sciences, Orsay, France). 23p. (CONF-407-6)

From Electro Chemical Society, Toronto, May 1964.

A duoplasmatron is described, whose design is modified so as to reduce the defocussing effects of space charge, which are encountered when the device is used as a source of heavy ions (such as Hg). The design of the duoplasmatron proper, the Hg supply, and the power supply is described. The effects of magnitude and shape of the magnetic field are investigated. (T.F.H.)

39422 REMOTE CONTROL APPARATUS FOR MANEUVERING MEMBERS WITHIN AN INACCESSIBLE SEALED ENCLOSURE. Philippe Wallet and Henri Taverne (to Commissariat à l'Energie Atomique). Canadian Patent 693,210. Aug. 25, 1964. Priority date Jan. 12, 1961, France.

An apparatus is described for fluid-tight actuation of a clamping device particularly for manipulating radioactive objects located on one side of an enclosure wall. A tubular member may be rotated through the enclosure wall being sealed by a fluid-tight connection. Provision is made for tilting the object to be manipulated. (F.S.A.)

Heat Transfer and Fluid Flow

Refer also to abstracts 39921, 40833, 40929, and 40931.

39423 (AAEC/TM-241) FLOW COAST-DOWN WITH CONVECTIVE HEATING IN A DOWN-FLOW LOOP. J. J. Thompson (Australia. Atomic Energy Commission Re-

search Establishment, Lucas Heights, New South Wales). Mar. 1964. 13p.

A simple loop model with initial down-flow through the heated section is analyzed, with regard to its transient performance following pump failure, to illustrate the phenomena likely to be of significance in the flow coast-down problem of a down-flow pebble bed reactor system. The analysis shows that the approach to equilibrium may be oscillatory and could involve flow reversal, indicating that this is a problem, calling for more detailed computations, in the feasibility study of a down-flow pebble bed reactor. (auth)

39424 (AE-153) MEASUREMENTS OF BURNOUT CONDITIONS FOR FLOW OF BOILING WATER IN VERTICAL 3-ROD AND 7-ROD CLUSTERS. Kurt M. Beck, Gunnar Hernborg, and Jan E. Flinta (Aktiebolaget Atomenergi, Stockholm). Aug. 1964. 54p.

Data were obtained in respect of heating the rods only, as well as for simultaneous uniform and non-uniform heating of the rods and the shroud. Totally, 520 runs were performed. In the case of equal heat fluxes on all surfaces of the channels, burnout always occurred on the rods, and the data were low by a factor of about 1.3 compared with round duct data. When only the rods were heated, the data showed very low burnout values in comparison with the results for total uniform heating and round ducts. This disagreement was explained by considering the climbing film flow model and the fact that only a fraction of the channel perimeter was heated. For simultaneous and non-uniform heating of the rods and the shroud, it was found that the shroud could be overloaded up to 50 per cent without reducing the margin of safety in respect of burnout for the rod cluster. Finally, a correlation for predicting burnout conditions in round ducts, annuli and rod clusters has been presented. This correlation predicts the burnout heat fluxes for the present measurements and previously obtained annuli measurements within ±5 per cent. (auth)

39425 (BNL-7390) ANALYTICAL STUDY OF HEAT TRANSFER TO LIQUID METALS IN CROSS FLOW THROUGH ROD BUNDLES. [PART] II. Chia-Jung Hsu (Brookhaven National Lab., Upton, N. Y.). May 22, 1963. Contract [AT(30-2)-Gen-16]. 42p.

Analytical expressions for the Nusselt number have been obtained for heat transfer to liquid metals flowing past a single elliptical rod or through elliptical-rod bundles, by assuming inviscid flow. These results can also be used for predicting Nusselt numbers in oblique cross-flow of liquid metals through bundles of circular rods. Expressions for Nusselt numbers for the following thermal conditions on the surface of a rod have been derived: (a) constant tube-wall temperature, (b) constant surface heat flux, and (c) cosine tube-wall temperature distribution. It was found that Nusselt numbers for normal cross-flow of liquid metals past an elliptic rod (single, or one inside a bundle) bear a certain relationship to those for the case in which the rods are circular. The relationships can be expressed by the following forms: For a single rod:

$$Nu_{ell}(Pe) = Nu_{cyl}(Pe)\sqrt{\frac{\sqrt{1-e^2}+(1-e^2)}{2-e^2}}$$

For a rod inside a bundle:

$$Nu_{ell}[Pe,\phi_1/(a+b)] = Nu_{cyl}(Pe,\phi_1/D)\sqrt{\frac{\sqrt{1-e^2}+(1-e^2)}{2-e^2}}$$

The above equations show that the average Nusselt number increases as the eccentricity of the ellipse decreases; and, at the limit where the eccentricity becomes zero, the Nusselt numbers reduce to those for the case of normal flow past a single circular rod or through a bundle of circular rods. The normalized hydrodynamic potential drop, $\phi_1/(a+b)$, which appears in the Nusselt numbers for elliptical-rod bundles was analytically evaluated by use of conjugate functions. It was found that the numerical values of the corresponding parameter, ϕ_1/D, for flow through circular-rod bundles were applicable here, provided that certain changes in notation were made. For the case where the liquid metal flows obliquely through the bundle, making a 45 degree angle with circular rods, the values of the parameter, $\phi_1/(a+b)$ are calculated with the aid of a high-speed digital computer. (auth)

39426 (COO-1177-16) TURBULENT FREE CONVECTION IN NEAR CRITICAL WATER. Jay Reinhold Larson and R. J. Schoenhals (Purdue Research Foundation, Lafayette, Ind.). Aug. 1964. Contract AT(11-1)-1177. 158p.

Thesis submitted by Jay Reinhold Larson to Purdue Univ., Lafayette, Ind.

Heat transfer from a vertical flat plate by turbulent free convection to water near its thermodynamic critical point was studied analytically and experimentally. An analytical method was developed to predict the magnitude and trend of the heat transfer coefficient in this region. This method of solution involved an integral technique whereby the boundary layer equations were integrated across the boundary layer. The method included assumptions of Reynolds analogy, the Blasius wall shear stress, and suitable velocity and temperature profiles. The energy equation was written in terms of enthalpy in order to avoid certain difficulties associated with the highly variable properties in the critical region. Experimental measurements were made of the heat flux from a platinum ribbon suspended in a pressure vessel containing the test water. The ribbon was heated electrically by direct current. The temperature of the ribbon was determined by resistance measurement and comparison with a previous calibration of the resistance-temperature curve of the test section. The temperature of the bulk fluid was determined by use of a platinum resistance thermometer. The experimental results indicate reasonable agreement with the analytical prediction. A correlation was also developed which gives reasonable predictions of the data in terms of the usual dimensionless parameters. (auth)

39427 (NAA-SR-Memo-9664) 500-THGC — A 500 NODE TRANSIENT HEAT TRANSFER CODE. R. A. Blaine and R. F. Berland (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Mar. 27, 1964. Contract [AT(11-1)-Gen-8]. 49p.

500-THGC is a generalized transient one, two, or three dimensional heat transfer code, with special options for handling SNAP circular orbit prestart-up and start-up problems. Provision is made for mass transfer, dropping the heat shield and simulating environmental conditions by means of effective temperatures. Use of FAP coding and special treatment of matrix multiplication are used to minimize machine time. (auth)

39428 (NAA-SR-Memo-9787) FLOW MEASUREMENTS USING NOISE ANALYSIS TECHNIQUES. R. L. Randall (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Apr. 15, 1964. Contract [AT(11-1)-Gen-8]. 9p.

A series of preliminary experiments were conducted, which apply to recently developed electronic cross spectral

density analysis equipment to the problem of coolant flow measurements. The basic approach involves monitoring random fluctuations in some localized property of the liquid (e.g., resistance, temperature) as it propagates past two or more detection devices. The signal from one detection device can be electronically compared with signals from other downstream detection devices and precise measurements of relative linear dependence (coherence) and the time shift (transit time) between the two signals can be obtained using cross spectral density analysis techniques. The results of these experiments have demonstrated the feasibility of the basic measurements methods, and have led to the design of experimental and analytical techniques for precisely measuring velocity profiles, volumetric flow rate, and determining information about the shape and characteristics of flow patterns. Detailed measurements of velocity profiles and flow patterns readily obtained using the techniques developed in the tests are difficult or impossible to obtain in liquid metals with conventional techniques. An important factor in these measurements is that only measurements of time and distance are required to determine velocity profiles and volumetric flow rates. Distances between the detection devices, radial locations and cross sectional areas can ordinarily be measured precisely leaving the time measurements as the major source of possible error. The ultimate statistical accuracy of the techniques for measuring the transit times could easily be made to exceed 1%. (auth)

39429 (NDA-10-51) HEAT TRANSFER TO FLUIDS WITH TEMPERATURE-DEPENDENT PROPERTIES. Kurt Goldmann (Nuclear Development Associates, Inc., White Plains, N. Y.). Apr. 1952. For Pratt and Whitney Aircraft Div., United Aircraft Corp., Middletown, Conn. Contract AT(30-1)-2303. 58p.

A summary of the work carried out during the last few months in connection with the prediction of heat transfer coefficients for supercritical water is presented. Possible mechanisms for heat transfer to supercritical water are discussed. Theories and experimental data regarding the analogy between turbulent momentum exchange and heat transfer for fluids with constant properties are briefly reviewed. A new method of analysis is proposed, which may be used to predict heat transfer coefficients for fluids with temperature dependent properties. Details of the new method are illustrated by a sample calculation for air. How this new method may be applied to calculate heat transfer coefficients for supercritical water is discussed, and the expected results of such calculations are estimated in a qualitative manner. (auth)

39430 (NYO-3114-2) THE TRANSITION FROM ANNULAR TO ANNULAR-MIST CO-CURRENT TWO-PHASE DOWNFLOW. Interim Report. D. A. Steen and G. B. Wallis (Dartmouth Coll., Hanover, N. H. Thayer School of Engineering). June 1964. Work Performed under United States–Euratom Joint Research and Development Program. Contract AT(30-1)-3114-1. 125p. (EURAEC-1147)

An investigation into the transition from annular to annular-mist two-component flow in vertical tubes is described. A sampling probe technique is used to determine the transition. The effect of different fluids and apparatus geometries upon the transition was examined, as well as the effect of changing the air density. High-speed motion pictures were used to examine the physical process of entrainment of a liquid film. The results are compared with previous investigations and a modified correlation for the transition gas velocity is suggested. (auth)

39431 (NYO-3304-1) INVESTIGATION OF TWO-PHASE FLOW AND BURNOUT. Quarterly Progress Report, December 15, 1963–June 15, 1964. Report No. 478. M. Suo, P. Goldberg, A. Bergles, L. Clawson, J. Bourne, and H. Mooncai (Dynatech Corp., Cambridge, Mass.). June 30, 1964. Contract AT(30-1)-3304. 22p.

Flow regimes and flow stability at burnout are studied for some simple geometries. Work has been directed towards building an experimental facility and planning the experimental program. Some work has also been done on flow regime prediction. (auth)

39432 (NYO-9940) THE FREQUENCY RESPONSE OF NUCLEATE POOL BOILING HEAT TRANSFER (thesis). Robert C. Lummis (Columbia Univ., New York. Engineering Research Labs.). [May 18, 1964]. Contract AT(30-3)-187. 188p.

A technique was developed for measuring the frequency response of the boiling heat transfer process and then applied to obtain a group of amplitude and phase response curves for one boiling system over a range of operating conditions. The system input was taken to be the varying component of the area-average heat flux density at the boiling interface, and the system output was taken to be the varying component of the area-average temperature at the interface. A special heating surface was developed which comprised a glass microscope slide onto the center of which a 100-Å thick film of nickel was vacuum deposited. The current waveform included a d-c component to establish the desired "quiescent" heat transfer rate and a varying component appropriate to the desired system input function. The area-average interfacial temperature was measured by employing the nickel film as a resistance thermometer. In order to employ the nickel film simultaneously as heater and thermometer, a method was developed to carry out each function in a different frequency band. The heating was produced by direct application of current with the proper waveform, while the resistance was determined by measuring the voltage developed by a ten-megacycle current. The heat transfer system to which this measuring technique was applied was nucleate pool boiling hexane. The nickel film was quite stable in hexane, and the boiling process was indistinguishable from boiling on more common surfaces, except that the surface superheat was unusually high. Amplitude and phase response were measured in the range 1.0 to 300 cycles per second, at each of three values of the bulk liquid temperature, three values of the quiescent heat flux density, and three amplitudes of the input sinusoid. It was found that (a) the response was close to that of a linear system for reasonable excursions of the heat flux density, (b) the quiescent heat flux density had only a moderate effect on the frequency response, although it had a pronounced effect on the fluid behavior near the interface, and (c) the liquid bulk temperature had a strong effect on the frequency response. At all of the conditions studied, the amplitude response displayed a gradual increase up to a certain frequency, and then a gradual decrease, asymptotically approaching the amplitude response of a conductive system of the same geometry. The phase was close to the minimum phase for this amplitude response. There were no sharp peaks or valleys, and no suggestion of resonance nor synchronization of the heat transfer with the bubble formation. With the bulk liquid temperature at 141°F, the maximum amplitude response was obtained at about 50 cycles per second, and was about 2°F ft^2 sec/Btu. At a bulk liquid temperature of 95°F, the maximum response occurred at about 10 cycles per second, and was about 6°F ft^2 sec/Btu. The

response curves are discussed in terms of the type of heat transfer controlling the response in different frequency ranges. (D.L.C.)

39433 (PWAC-428) EVALUATION AND PERFORMANCE OF ONCE-THROUGH, ZERO-GRAVITY BOILER TUBES WITH TWO-PHASE WATER. E. Bernstein, J. P. Petrek, and J. Meregian (Pratt and Whitney Aircraft Div., United Aircraft Corp. Connecticut Aircraft Nuclear Engine Lab., Middletown). July 2, 1964. Contract AT(30-1)-2789. 105p.

Forced-convection heat transfer and pressure drop were experimentally determined for two-phase water flowing inside small tubes. Six basically different tube shapes were tested, with two being selected as best for further development as once-through, zero-gravity, high temperature liquid metal boiler tubes. Tube reliability and fabricability were also considered in the selection. (auth)

39434 (PWAC-429) EXPERIMENTAL RESULTS OF FORCED CONVECTION BOILING POTASSIUM HEAT TRANSFER AND PRESSURE DROP TESTS. E. Bernstein, J. P. Petrek, G. J. Rose, and J. J. Horan (Pratt and Whitney Aircraft Div., United Aircraft Corp. Connecticut Aircraft Nuclear Engine Lab., Middletown). July 16, 1964. Contract AT(30-1)-2789. 84p.

Experimental forced-convection boiling K heat transfer and pressure drop data were obtained at 1725°F in a horizontal zero gravity boiler tube. System stability tests were conducted and the results compared with an electric analog of the system. A distinct condensing interface was observed in the condenser. (auth)

39435 (TID-20947) THE BUBBLY-SLUG TRANSITION IN A HIGH-VELOCITY TWO-PHASE FLOW. Technical Report No. 5003-29. Peter Griffith and George A. Snyder (Massachusetts Inst. of Tech., Cambridge. Div. of Sponsored Research). July 1964. Contract AT(30-1)-3301. 34p.

A possible mechanism for the transition between bubbly and slug flow is proposed and tested in a simulated slug flow system. No sudden collapse of slug flow with increasing velocity is found. It is concluded that: slug flow is generally stable at voids greater than 35%; bubbly flow at voids higher than this is a result of entrance conditions; and visual observations of bubbly flow in unheated systems at higher voids are most likely faulty. No simple asymptote limit or criterion that would predict the location of the bubbly-slug transition was found. (auth)

39436 (TID-21031) BURNOUT IN LONG VERTICAL TUBES WITH UNIFORM AND COSINE HEATING USING WATER AT 1000 PSIA. Topical Report No. 1. J. E. Casterline and Bruce Matzner (Columbia Univ., New York. Engineering Research Labs.). July 27, 1964. Contract AT(30-3)-187. 57p.

The effect of a cosine distribution of heat flux in the axial direction along an internally cooled, tubular test section at high pressure was experimentally determined. The program consisted of the operation of two electrically heated tubular test sections, both 16 feet long with 0.400" I.D. The heat flux in one tube was uniform in the axial direction, while the other had a cosine heat flux. Incipient burnout and pressure drop were the principal experimental measurements. It was found that the local conditions, at burnout, in the cosine tube were similar to those in the uniformly heated tube at coolant mass velocities of 3×10^6 lb/hr ft^2 and higher. For lower mass velocities, the cosine tube supported higher heat fluxes, for the same local conditions. The maximum total power of the cosine tube, in general, was greater than that attained with the uniform tube. Regions of severe pressure oscillations (up to ±40 psi) were observed and two-phase flow versus total pressure-drop characteristics were determined. (auth)

39437 (UCRL-11552) MEASUREMENT OF THE VELOCITY OF GASES IN A FIELD OF VARIABLE COMPOSITION AND TEMPERATURE. Robert M. Davis, Darshanlal T. Wasan, and Charles R. Wilke (California. Univ., Berkeley. Lawrence Radiation). Aug. 11, 1964. Contract W-7405-eng-48. 129p.

An experimental study is undertaken to observe the effects of mass transfer on the fully-developed turbulent velocity field in a pipe. Water is vaporized from the wetted walls of a short cylindrical section; a hot wire anemometer is used to measure the time-averaged velocity distribution (velocities ranging from 0.2 to 6 ft/sec) of a gas stream with variable composition and temperature which flows through the pipe. The conventional theory for hot wire anemometry is extended to include the effects of natural and forced convection to gases having variable fluid properties. Several independent tests demonstrate that hot wire anemometry is a reliable technique for the measurement of low velocities under conditions of variable composition and temperature. Velocity and temperature profiles are measured with and without vaporization conditions at 20 to 55°C and for the Reynolds numbers of 9000 to 17,000. Comparison of the velocity profiles measured with and without mass transfer indicates that the vaporization process does not appreciably alter the velocity distribution under the conditions encountered. (auth)

39438 (UCRL-11570) MASS TRANSFER IN COCURRENT GAS-LIQUID FLOW. Jon M. Heuss, C. Judson King, and Charles R. Wilke (California. Univ., Berkeley. Lawrence Radiation Lab.). Aug. 7, 1964. Contract W-7405-eng-48. 124p.

The absorption of NH_3 and O_2 in horizontal cocurrent gas-liquid froth flow in a 1-in.-ID pipe was investigated. At superficial liquid rates between 2×10^6 and 3.2×10^6 lb/hr-ft^2 and superficial gas rates between 5×10^3 and 18×10^3 lb/hr-ft^2 the length of a transfer unit in both systems was between 0.5 and 4 ft. The effects of distance and temperature were also investigated. The absorption of NH_3 was almost entirely gas-phase controlled; the absorption of O_2 was almost entirely liquid-phase controlled. The individual phase coefficients k_La and k_Ga are reported. Using James and Silberman's data on bubble size and distribution in froth flow to estimate average bubble sizes, the NH_3 absorption could be qualitatively and quantitatively explained by the model of unsteady state transfer from a stagnant sphere. Using an interfacial area estimate from the NH_3 results, the O_2 absorption data were correlated by a Sherwood Number characterizing the transfer from the bubbles, a Reynolds Number characterizing the turbulence within the system, and the void fraction. The void fraction was calculated from the Hughmark correlation. Pressure gradients were correlated by a modification of the Bankoff variable density homogeneous flow model. (auth)

39439 (WCAP-4402) REVIEW OF LIQUID METAL HEAT TRANSFER AND PRESSURE DROP. L. E. Efferding and A. A. Bishop (Westinghouse Electric Corp. Atomic Power Div., Pittsburgh). Oct. 1963. Contract AT(30-1)-3251. 99p.

A review of liquid metal heat transfer technology was

made to obtain a reliable set of design equations for nuclear reactors. Although there are numerous heat transfer programs active, there are many areas where experimental and analytical investigations are required. Based on the experimental data and analytical results available, a group of equations are recommended for preliminary reactor design. Discussion and comparison of analytical predictions and experimental results and recommendations for additional work are also included. (auth)

39440 DETERMINATION OF THE CRITICAL PARAMETERS OF ORDINARY AND HEAVY WATER. S. L. Rivkin and T. S. Akhundov (All-Union Heat Engineering Inst., USSR). High Temp., 1: 295-301(Nov.-Dec. 1963). Translated from Teplofiz. Vysokikh Temp., 1: 329-37 (Nov.-Dec. 1963).

Data on the specific volumes of the two types of water near the critical region are examined in order to obtain better values for the critical parameters. The methods of determination are presented, together with the critical volumes. (auth)

39441 ON THE EFFECT OF SUBCOOLED WATER FLOW VELOCITY ON BURNOUT HEAT FLUXES. B. A. Zenkevich. Inzh. Fiz. Zh., Akad. Nauk Belorussk. SSR, 7: 43-6(July 1964). (In Russian)

It is shown that the enthalpy and pressure of water influence the character of burnout heat flux dependence upon the subcooled water flow velocity. In some ranges of the regime parameters the influence of the flow velocity on burnout heat flux may be negative. There is no published work, however, where this fact was pointed at. The burnout heat flux can be obtained from an equation for the pressure range from 3×10^5 to 206×10^5 N/m^2 and from an equation for the pressure range from 1×10^5 to 15×10^5 N/m^2. (auth)

39442 BURNOUT IN MULTIROD GEOMETRY. John S. Wiley. Power Reactor Technol., 7: No. 2, 154-66(Spring 1964).

Burnout heat-flux correlations of heated rod bundles are analyzed and compared with simple channel configurations using data from 15 references. (N.W.R.)

39443 A GENERAL TRANSFER-EQUATION APPROACH FOR THE TRANSITION REGIME OF RAREFIED-GAS FLOWS AND SOME OF ITS APPLICATIONS. S. F. Shen (Cornell Univ., Ithaca, N. Y.). Proc. Intern. Symp. Rarefied Gas Dyn., 3rd, Paris, 1962, 2: 112-31(1963).

For solving the boundary-value problem of the Boltzmann equation at arbitrary Knudsen number, it is proposed to use the transfer equations with approximate distribution functions that exhibit the proper collision effects. Such a distribution function is deduced by an elementary analysis of the simpler Krook equation. It may be regarded as of the relaxation type, changing from the free-molecule limit to the continuum limit exponentially with the number of collisions. Applications to the linearized plane and cylindrical Couette flows are made. Though more cumbersome than earlier, simpler approaches, the present theory is fundamentally more defensible and seems to yield better details in the Knudsen layer. (auth)

39444 A MOLECULAR APPROACH TO RAREFIED GAS DYNAMICS. W. J. Schaetzle (Washington Univ., St. Louis). Proc. Intern. Symp. Rarefied Gas Dyn., 3rd, Paris, 1962, 1: 136-58(1963).

The problem of rarefied gas dynamics is approached using a microscopic finite difference type of solution similar to the relaxation technique used in heat conduction problems for odd shaped configurations. The flow field is divided into small cubical elements, and an approximate molecular velocity distribution is assigned to the molecules at the corners of each element. The molecules entering the flow field from the boundaries of the problem, such as free stream flow or surfaces, are assigned fixed molecular density distributions. The molecular velocity distributions at the corners of the elements are then evaluated as a function of the surrounding flow field. If the evaluated value for the molecular velocity distribution is different from the assigned value, a new value is assigned to the point. This iteration process continues until the molecular velocity distributions at each point in the flow field are in equilibrium with the velocity distributions in the surrounding flow field and at the boundaries. The technique was used to calculate Couette flow and the boundary layer at the leading edge of a flat plate in low speed incompressible flow. The computation for the problems was made on the IBM-704 digital computer. (auth)

39445 HEAT TRANSFER IN A RAREFIED GAS BETWEEN PARALLEL PLATES AT LARGE TEMPERATURE RATIOS. D. Roger Willis (Princeton Univ., N. J.). Proc. Intern. Symp. Rarefied Gas Dyn., 3rd, Paris, 1962, 1: 209-25(1963).

Using a relaxation type model to describe the intermolecular collisions, the problem is reduced to the solution of two coupled nonlinear integral equations for the density and temperature of the gas. An analytic solution of these equations is obtained for the limiting case of very high plate temperature ratio. Numerical results are obtained for several temperature ratios, the lowest being 4 to 1, and for a state of rarefaction varying from free molecular to the transition regime. The numerical results are compared with results of a moment method, using four moments, and a first iterate method. The results of this moment method are found to be insufficiently sensitive to variations in the plate temperature ratio. The numerical results for a temperature ratio of 4 to 1 correlate reasonably well with results of a linearized eight moment method through use of a modified rarefaction parameter. (auth)

39446 ELECTRON EXCITATION APPLIED TO THE EXPERIMENTAL INVESTIGATION OF RAREFIED GAS FLOWS. E. P. Muntz (Univ. of Toronto and General Electric Co., Philadelphia) and D. J. Marsden. Proc. Intern. Symp. Rarefied Gas Dyn., 3rd, Paris, 1962, 2: 495-526 (1963).

When high energy electrons pass through a gas, inelastic collisions between the electrons and gas atoms result in a characteristic emission spectrum. The intensity and spectral details of the emission are related to the nature, density, and temperature of the gas, as well as to the energy and number density of the electrons. As a consequence of this, the electroluminescence produced by a known and controlled stream of electrons may be used to determine some otherwise difficult to measure properties of rarefied gas flows. These include: the number density of a particular species, and for some gases the vibrational and rotational temperatures of the molecules in the flow. (auth)

39447 MAGNETOHYDRODYNAMIC COUETTE FLOW AS AFFECTED BY WALL ELECTRICAL CONDUCTANCES. James T. Yen and Chieh-chien Chang (Catholic Univ. of America, Washington, D. C.). Z. Angew. Math. Phys., 15: 400-7(July 25, 1964).

The flow of a viscous, incompressible, electrically conducting fluid, bounded by two moving walls, under the influence of a uniform transverse magnetic field was analyzed. For equal wall conductances, the flow becomes antisymmetric with no electric field present. Magnetic and viscous drag coefficients, velocity profiles, and magnetic field profiles were obtained for different conductances. (D.C.W.)

39448 HEAT TRANSFER TO MAGNETOHYDRODYNAMIC FLOW IN A FLAT DUCT. L. E. Erickson, C. S. Wang, C. L. Hwang, and Liang-tseng Fan (Kansas State Univ., Manhattan). Z. Angew. Math. Phys., 15: 408-18 (July 25, 1964).

Heat transfer to an electrically conducting fluid flowing between two infinite plates with a magnetic field perpendicular to the plates and the electric current parallel to the plates was analyzed for the case of constant plate temperature. (D.C.W.)

39449 EFFECTS OF EXTERNAL CIRCUIT AND WALL CONDITIONS ON MAGNETOHYDRODYNAMIC FREE CONVECTION BETWEEN TWO HEATED WALLS. Frederick J. Young, and H. Huang (Carnegie Inst. of Tech., Pittsburgh). Z. Angew. Math. Phys., 15: 419-25(July 25, 1964).

The effects of external circuit conditions and wall electrical conductances on fully developed convection of a fluid between two heated walls were studied, using an iteration method to solve the governing system of nonlinear integro-differential equations. (D.C.W.)

39450 THE DISCHARGE OF SATURATED WATER THROUGH TUBES. H. K. Fauske (Argonne National Lab., Ill.). New York, American Inst. of Chemical Engineers, 1964, Preprint No. 30, 30p. $0.50. (CONF-644-3)

From 7th National Heat Transfer Conference, Cleveland, Aug. 1964.

High-pressure data are presented for the discharge of saturated water through tubes having length/diameter ratios less than 40, and having varying lengths. Critical pressure ratios under these conditions are reported. The conditions under which various critical flow models may be applied are pointed out. The implications of the results as regards reactor accidents involving coolants are outlined. (T.F.H.)

39451 REMARKS ON THE LIQUID METAL CONDENSATION. Jon Lee (Aerospace Research Labs., Wright-Patterson AFB, Ohio). New York, American Institute of Chemical Engineers, 1964, Preprint No. 1, 28p. $0.50. (CONF-644-13)

From 7th National Heat Transfer Conference, Cleveland, Aug. 1964.

In comparison to the laminar model, the presence of turbulent transports decreases heat transfer coefficient for condensation, h_{av}, less than 10% within the experimental range of small Re_L. The upward vapor flow can decrease h_{av} significantly, and the computed $h_{av}-Re_L$ correlations with maximum vapor velocity of 46.8 ft/sec cover all the data of Misra and Bonilla. In retrospect, it is fair to point out a few deficiencies of the analysis. They are: $u_\infty = -u_0 x^{1/4}$ may not approximate the actual vapor flow, nor do we know the actual vapor velocity in condensation experiments (other than the visual observations made by Misra and Bonilla); and the boundary-layer model may not be valid when the film thickness and vapor flow become large, due to the hydrodynamic instability of the liquid-vapor interface. It is strongly suspected that an equilibrium flow will exist under finite disturbance, so that the actual film thickness is controlled by the hydrodynamics rather than $C_p \Delta t/\lambda$. (auth)

39452 A STUDY OF SATURATED POOL BOILING POTASSIUM UP TO BURNOUT HEAT FLUXES. C. P. Colver (Univ. of Oklahoma, Norman) and R. E. Balzhiser. New York, American Inst. of Chemical Engineers, 1964, Preprint No. 27, 34p. $0.50. (CONF-644-10)

From 7th National Heat Transfer Conference, Cleveland, Aug. 1964.

Saturated pool boiling potassium burnout data can be represented by a straight line when plotting the burnout heat flux versus the saturation pressure on a log-log plot. Furthermore, burnout measurements obtained at constant flux by decreasing the pressure or at constant pressure by increasing the heat flux give consistent results. Existing burnout correlations based on liquid thermal transport properties as well as hydrodynamic properties of a two-phase system do not successfully predict the experimental potassium burnout data obtained in this study. The nucleate boiling curve for potassium in a saturated pool may be predicted within the uncertainties of this study by the equations of Chang-Snyder, Forster-Greif, and Forster-Zuber. In addition, the data compared favorably with the potassium results of Bonilla. Mean wall superheats were in the order of 20°F for heat fluxes over 100,000 Btu/(hr)(sq ft). Pronounced temperature fluctuations between 10 and 150°F exist in the heat transfer surface during the boiling of potassium. Below 250,000 Btu/(hr)(sq ft) temperature fluctuations were observed in the bulk liquid and were usually accompanied by noticeable pressure fluctuations. (auth)

39453 SELECTION AND PERFORMANCE OF NaK HEATING SYSTEMS FOR A FLUIDIZED BED PROCESS. E. S. Grimmett (Phillips Petroleum Co., Idaho Falls, Idaho). New York, American Inst. of Chemical Engineers, 1964, Preprint No. 36, 23p. $0.50. (CONF-644-1)

From 7th National Heat Transfer Conference, Cleveland, Aug. 1964.

The paramount requirements which influenced the choice of the heating system for the fluidized bed waste calcination process were: The amount of off-gas leaving the fluidized bed should be minimized. The system should operate at as high a temperature as possible, subject to the limitations imposed by the materials of construction required by the process. The system should operate at or near atmospheric pressure. The system should be flexible and easy to operate so that the temperature in the fluidized bed can be held at any desired value within the operating range of 300 to 600°C. A liquid metal (NaK) system was selected as the one which best fulfilled these requirements. Operation of a NaK heating system, in a pilot plant calciner and a production scale calciner, proved that the choice of a liquid metal heating system for this process was a good one. Operation of both systems pointed up some factors which caused initial problems but which were eliminated by adopting the following design and operating principles: minimizing thermal and vibrational stresses, maintaining extreme cleanliness within the liquid metal system, and careful inspection and testing of all components and materials prior to installation. (auth)

39454 A STUDY OF INDUCED CONVECTIVE EFFECTS ON SATURATED POOL BOILING BURNOUT. C. P. Costello, C. O. Bock, and C. C. Nichols (Univ. of Washington, Seattle). New York, American Inst. of Chemical Engineers, 1964, Preprint No. 7, 27p. $0.50. (CONF-644-8)

From 7th National Heat Transfer Conference, Cleveland, Aug. 1964.

There are appreciable size and surface effects in pool boiling burnout. Heaters which were run in tap water for a long period of time, and which therefore have improved wet-

ability, burn out at fluxes well above those attainable with clean heaters. The burnout heat flux was increased by a factor of 2.3 for heaters of identical materials, wall thickness, restrictions on liquid inflow, and running times if tap water rather than distilled water was used. Smaller heaters burn out at substantially higher heat fluxes than do larger ones. For clean heaters, the burnout heat flux for $\frac{1}{8}$-in.-dia semicylinders was 2.5 that attainable with flat-plate heaters with no liquid inflow from the sides. For heaters run in tap water, $\frac{1}{16}$-in.-dia semicylinders burned out at fluxes 2.7 times as great as that attainable with flat-plate heaters with no liquid inflow from the sides. It appears that a substantial convective effect exists and that the magnitude of the effect may be adequate to explain the variation in burnout heat flux with heater size, at least for heaters of width one-half inch or more. It also appears that on a time-averaged basis, far more than enough liquid flows in from the sides of a heater two inches or less in width to supply the mass of vapor required in the boiling process. This suggests that burnout must be ascribable to local effects, such as dryout under vapor. The data appear to be explainable by assuming that burnout occurs when a certain heat flux must be dissipated by latent heat transport. The total heat flux at burnout is the sum of the latent heat transport and the energy removed by convection. Since $(q/A)_c$ is conservatively estimated as 141,000 Btu/hr ft^2 for one-half inch wide, clean heaters, the convective component can apparently account for at least 47% of the total heat flux at burnout for such heaters. (auth)

39455 HIGHER COEFFICIENTS FOR HEAT TRANSFER WITH NUCLEATE BOILING. R. K. Young and R. L. Hummel (Univ. of Toronto). New York, American Inst. of Chemical Engineers, 1964, Preprint No. 18, 29p. $0.50. (CONF-644-9)

From 7th National Heat Transfer Conference, Cleveland, Aug. 1964.

High coefficients in the lower region of the nucleate boiling regime were made possible by provision of poorly wetted spots on a metal surface that is wetted by the boiling liquid. The use of these spots for promotion of boiling is an important new tool for boiling research because the upper limit of the active site density at the heated surface for moderate heat fluxes can now be precisely fixed by pretreatment of the surface. (auth)

39456 UNSTEADY TEMPERATURE DISTRIBUTIONS IN FINITE REGIONS. N. Y. Olcer (Ordnance Engineering Associates, Inc., Des Plaines, Ill.), David Miller, and J. E. Sunderland. New York, American Inst. of Chemical Engineers, 1964, Preprint No. 32, 19p. $0.50. (CONF-644-2)

From 7th National Heat Transfer Conference, Cleveland, Aug. 1964.

Expressions are given for unsteady temperature distributions in finite regions with time-dependent boundary conditions and heat sources. A method is given which eliminates the occurrence of the convolution integrals in the solutions when the source functions are expressed in terms of polynomials or given by their Taylor series expansion in time. The solutions are then transformed into sums of quasi-steady and transient terms. (N.W.R.)

39457 HEAT TRANSFER COEFFICIENTS IN LIQUID METAL CO-CURRENT FLOW DOUBLE PIPE HEAT EXCHANGERS. R. P. Stein (Argonne National Lab., Ill.). New York, American Inst. of Chemical Engineers, 1964, Preprint No. 13, 30p. $0.50. (CONF-644-4)

From 7th National Heat Transfer Conference, Cleveland, Aug. 1964.

The material presented represents an introductory analytical investigation of liquid metal heat transfer in co-current flow double pipe heat exchangers without use of the usual heat transfer coefficient assumptions implicit in the more customary methods of analysis. In order to provide mathematical simplicity, plug flow models of the heat exchanging fluids were utilized for analysis, and an approximation method developed for application of plug flow results in general to the turbulent flow of liquid metals. Evidence was presented which indicates that the approximation will give satisfactory accuracy up to Peclet numbers of 1000 and perhaps larger. The plug flow analysis and approximation method were applied to the prediction of the dependence of fully developed individual channel (film) heat transfer coefficients on the operating conditions of two types of liquid metal co-current flow double pipe heat exchangers. It was found that operating conditions and exchanger type can be important in this regard, and that fully developed heat transfer coefficients can be significantly lower than normally expected. (auth)

39458 THE GRAETZ PROBLEM IN CO-CURRENT FLOW DOUBLE PIPE HEAT EXCHANGERS. R. P. Stein (Argonne National Lab., Ill.). New York, American Inst. of Chemical Engineers, 1964, Preprint No. 11, 46p. $0.50. (CONF-644-5)

From 7th National Heat Transfer Conference, Cleveland, Aug. 1964.

It is shown that the Graetz Problem pertaining to the co-current flow double pipe heat exchanger can be studied analytically by extensions of familiar mathematical techniques. When applied to the corresponding plug flow problem, the analytical solution obtained by application of these techniques agrees with a solution obtained previously by Laplace transform methods. When applied to the laminar flow problem, a well known approximation method was used to obtain numerical results of interest with moderate success. (auth)

39459 GRADUAL TRANSITION OF NUCLEATE BOILING FROM DISCRETE-BUBBLE REGIME TO MULTIBUBBLE REGIME. Yih-yun Hsu (Lewis Research Center, Cleveland). New York, American Inst. of Chemical Engineers, 1964, Preprint No. 35, 30p. $0.50. (CONF-644-12)

From 7th National Heat Transfer Conference, Cleveland, Aug. 1964.

A photographic study was made of over 5000 bubbles in the nucleate boiling of methanol and water on a narrow heating strip at various heat fluxes and degrees of subcooling. The result showed that transition from the discrete-bubble regime to the multibubble regime was gradual. The fraction of heating area covered by multibubbles increases with the increasing heat flux and is predictable. The area fraction is a Poisson function of the product of the mean area of influence of single bubbles and the instantaneous population density. (auth)

39460 SOME EFFECTS OF TEST SECTION GEOMETRY, IN SATURATED POOL BOILING, ON THE CRITICAL HEAT FLUX FOR SOME ORGANIC LIQUIDS AND LIQUID MIXTURES. M. Carne (Atomic Energy of Canada Ltd., Chalk River, Ont.). New York, American Inst. of Chemical Engineers, 1964, Preprint No. 6, 35p. $0.50. (CONF-644-7)

From 7th National Heat Transfer Conference, Cleveland, Aug. 1964.

The critical heat fluxes of organic liquids are independent of element diameter, d, for solid elements with d $\leq \frac{3}{32}$ in., but are 15 to 40% higher for d $\geq \frac{1}{16}$ in. Decreasing the wall

thickness, for elements with diameters greater than $^3/_{32}$ in., decreases the critical heat fluxes of organics by factors similar to those reported for water. The large peaks in critical heat flux, previously reported by Van Wijk for water–organic binaries, were due to a flux depression at high water concentrations resulting from the use of small-diameter elements. The magnitudes of the peaks were reduced and in many cases the peaks were eliminated when boiling on a $^1/_8$-in. diameter element. The form of the correlation equation for critical heat flux proposed by Kutateladze is not adequate for predicting the behavior of organics. Stable transition boiling can occur at random localized zones on the surface of an electrically heated element. The variation of critical heat flux with wall thickness is a variation in the surface average heat flux, which can be explained qualitatively by a constant local maximum heat flux and heat conduction processes at the local zones of transition boiling. (auth)

39461 BURNOUT AND HEAT TRANSFER CORRELATIONS FOR ONCE-THROUGH-SUPERHEAT AT LOW FLOW WITH AN EXPONENTIAL SOURCE. E. E. Duke (General Dynamics/Astronautics, San Diego, Calif.). 29p. (CONF-446-17)

From American Nuclear Society 10th Annual Meeting, Philadelphia, June 1964.

Burnout and heat transfer correlations have been obtained from experimental data in a "Once-Through-Superheat" channel with an exponential source. Such electrically heated variation with length permits local heat fluxes to approximate burnout limits in order to maximize total heat input to a test section. Two statistical correlations as a function of the process variables are developed, namely burnout heat flux in the high quality region, and superheat production from 0 to 235°C. The range of the independent process variables are: pressure, 520 to 1900 psig; flow, 0.0108 to 0.242×10^6 lbs/hr.-ft.^{2}; and subcooling, 0 to 327°F. (auth)

39462 FURTHER NOTES ON CONVERGENCE TECHNIQUES FOR IMPLICIT NUMERICAL SOLUTION OF THE DIFFUSION EQUATION FOR TRANSIENT HEAT TRANSFER. R. T. Poppe and B. Kaplan (Air Force Inst. of Tech., Wright-Patterson AFB, Ohio). 20p. (CONF-446-21)

From American Nuclear Society 10th Annual Meeting, Philadelphia, June 1964.

A technique is developed semi-empirically for accelerating or forcing the convergence of the Gauss–Seidel iteration method for solving the simultaneous heat-balance equations. The technique is based on a unique modification of the Wegstein (Commun. ACM (Assoc. Computing Machinery), 1: 9(1958)) method. The speed of convergence of this adaptation of the Wegstein technique is compared with that of the over-relaxation method. (T.F.H.)

Materials Testing

Refer also to abstracts 39058 and 39528.

39463 (EURAEC-663) NON-DESTRUCTIVE EXAMINATION OF WELDS. Quarterly Report No. 7, January 1–March 31, 1963. Report No. X-200/7/1963. (Röntgen Technische Dienst N. V., Rotterdam). June 15, 1964. Work Performed under United States–Euratom Joint Research and Development Program. Contract 045-61-5-RDH. 19p.

Ultrasonic and x-ray radiographic inspection of steel welds is evaluated. The techniques used are analyzed. (N.W.R.)

39464 (EURAEC-762) NON-DESTRUCTIVE WELD EXAMINATION. Quarterly Report No. 8, April 1–June 30, 1963. Report No. X-200/8/1963. (Röntgen Technische Dienst N. V., Rotterdam). June 30, 1964. Work Performed under United States–Euratom Joint Research and Development Program. Contract 045-61-5-RDH. 22p.

Ultrasonic and x-ray radiographic inspection of steel welds is evaluated. The techniques and equipment used are analyzed. (N.W.R.)

39465 (IITRI-N213-20) NONDESTRUCTIVE METHODS OF EVALUATING COATING-METAL BONDS. Quarterly Report No. 7. William E. Lawrie and M. D. Oestreich (Illinois Inst. of Tech., Chicago. IIT Research Inst.). July 13, 1964. Contract AF33(657)-8938. 36p.

The development of nuclear and ultrasonic methods for the evaluation of oxidation-resistant coatings for refractory metals is described. The coating parameters to be determined are the overall thickness, the thicknesses of each layer in a multilayer coating, and the presence of discontinuities that may possibly hasten coating failure. The emphasis in the ultrasonic activities was in developing apparatus and methods for making high-frequency Rayleigh waves. Water-filled wedge transducers were constructed, and new transistorized electronic amplifiers were constructed for use in the frequency range of 60 to 100 Mc/s. Backscatter measurements using magnetically separated electrons from a Sr beta source showed that a high degree of success can be anticipated in the analysis of multilayer coatings by beta backscatter. In order to improve the monoenergetic quality of the incident electrons, as well as permit easy selection of electron energy, an electromagnetic beta spectrometer was constructed. Backscatter measurements using this new device are just beginning. The utilization of various radioactive penetrant techniques was evaluated in some detail, and the use of both a radioactive salt solution and a radioactive gas for the penetrant was indicated as worthy of experimental study. (auth)

39466 (LA-DC-6289) THE ESTABLISHMENT OF A NEUTRON RADIOGRAPHY PROGRAM AT THE LOS ALAMOS SCIENTIFIC LABORATORY. B. L. Blanks and R. A. Morris (Los Alamos Scientific Lab., N. Mex.). June 26, 1964. Contract W-7405-eng-36. 30p. (CONF-662-1)

For Presentation at 24th National Convention of Society for Nondestructive Testing, Philadelphia, Oct. 1964.

The Los Alamos Water Boiler Reactor, having a maximum power of 45 kilowatts, has been used as a neutron source for neutron radiography. Experiments with various foil-film combinations have verified some of the published results. A neutron beam collimation device has been developed to improve the image resolution obtainable with this system. The application of neutron radiography to the inspection of several reactor components has been evaluated. (auth)

39467 (NAA-SR-9924) THE DESIGN BASIS FOR PINHOLE GAMMA-RAY CAMERAS. M. A. Greenfield and R. L. Koontz (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Sept. 15, 1964. Contract AT(11-1)-Gen-8. 37p.

A theory is presented for the performance of pin-hole

gamma-ray cameras in terms of the parameters: sensitivity, resolution, field of view, contrast, magnification, and exposure times. The theoretical expressions for the sensitivity and resolution are shown to be in good agreement with experiment. Several cameras were built of depleted uranium to achieve a desired level of resolution and sensitivity. All the cameras have been used successfully to examine irradiated fuel pins nondestructively and are capable of demonstrating damage, swelling, and cracking in fuel rods. These cameras are being used at both the Component Development Hot Cell at Atomics International and in a hot cell at the Hallam Nuclear Power Facility. The resolution of these cameras is of the order of 10 to 20 mils, depending on the average photon energy of the source being viewed. For fission product gamma rays the resolution is approximately 20 mils, and the diameter of the field of view is 4 in. at a distance of 2 ft from the camera's center. (auth)

39468 (WAPD-TM-417) STRUCTURE DESIGN NOTES: CALCULATION OF STRESSES, FORCES, AND DEFLECTIONS IN LINEAR-ELASTIC SKELETON STRUCTURES WITH TEMPERATURE, PRESSURES, APPLIED LOADS AND REDUNDANT LOADS. C. M. Friedrich (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Apr. 1964. Contract AT-11-1-GEN-14. 93p.

Matrix theory was successfully used for subassembly stresses, shock and vibration responses, thick shells of revolution, and other problems for linear elastic structures. A new program, M0397, was written with simplified matrix input to help the engineer solve structure problems. Sample problems are discussed to explain the theory and to show how to determine the effects of thermal distortions and mechanical clearances. M0397, called CTAC, is an ALTAC-3 program written in FORTRAN II for a 32 k word computer with five tapes. (auth)

39469 REPORT ON METHODICAL STUDIES IN RADIOAUTOGRAPHY. W. Herrmann, G. Hartmann, and K. Freyer (Institut für Angewandte Radioaktivität, Leipzig). Kernenergie, 7: 540-3(June-July 1964). (In German)

Autoradiographic techniques employed at the Institute for Applied Radioactivity are described. The contact method, luminescence method, pin-hole camera for beta radiation, pin-hole camera for gamma radiation, magnetic lenses for beta radiation, autoradiography of doubly labeled objects, luminescence method for rendering an image from a nonradioactive surface, alpha radiography, and quantitative autoradiography of substances emitting beta radiation are discussed. The image-rendering performance and other pertinent characteristics of these techniques are discussed and their respective advantages and disadvantages listed. (M.C.G.)

39470 PLUTONIUM HANDLING FACILITIES FOR RADIOGRAPHY. A. L. Dighton, J. C. Sampson, Jr., and W. D. Stump (Dow Chemical Co., Denver). Mater. Evaluation, 22: 401-3(Sept. 1964).

An enclosed glove box was constructed to facilitate operations in radiography of plutonium. Tests showed that no significant detail is lost in radiographing dense materials greater than 0.020 in. thick through 0.120 in. of aluminum, using energies in the 1-Mev range. (auth)

39471 NEUTRON RADIOGRAPHY. Harold Berger (Argonne National Lab., Ill.). Sci. Am., 207: 107-19 (Nov. 1962).

The principles, technique, and applications of neutron radiography, and especially its differences from and advantages over x-ray photography, are discussed along with recent developments in improved neutron sources that will help neutron radiography realize its full potential. (TCO)

39472 RADIATION PROTECTION AND RADIOACTIVE ISOTOPES IN THE NONDESTRUCTIVE TESTING OF MATERIALS. Egon Becker (Hochschule Schwer-Waschinenban, Magdeburg, Ger.). Wiss. Z. Hochsch. Schwermaschinenbau Magdeburg, 4: 147-56(1960). (In German)

The influence of ionizing radiation on living organisms, its relative biological efficiency as well as radiation sensitivity of organs and tissues of the human body are described. The protective measures applied to nondestructive testing of materials and the construction of test rooms are described in detail, whereby with the help of charts and diagrams the necessary spacings or thicknesses of material are communicated for the observation of the permissible dosages in accordance with the recommendations of the ICRP of 1958. (auth)

39473 SYMPOSIUM ON DYNAMIC BEHAVIOR OF MATERIALS. ASTM Materials Science Series-5. Presented at Albuquerque, N. Mex., September 27-28, 1962. (American Society for Testing Materials, Philadelphia). ASTM Special Technical Publication No. 336. Oct. 1963. 322p. $13.00.

Sixteen articles are included. Information is presented on: high-speed testing of plastics; high-speed compression testing of thermoplastics; dynamic mechanical properties of polyethylene; behavior of filamentous materials subjected to high-speed tensile impact; impact performance of HT-1 and nylon webbings to mach 0.7; experimental solid dynamics; metallurgical effects of explosive straining; plastic wave propagation in rods; plastic impacts on short cylindrical specimens; measurement of dynamic plastic flow properties under uniform stress; submicrosecond technique for simultaneous observation of input and propagated impact stresses; production of strong shocks in plastics by ultra-short impulsive loading; experiments on the mechanism of spall; low-pressure spall thresholds in Cu; fracture of single crystals under explosive loading; and residual temperatures of shock-loaded Fe. (P.C.H.)

39474 A HIGH-ENERGY SHOCK FACILITY USING ELECTROMAGNETIC ENERGY. Thomas F. Meagher (Sandia Corp., Livermore, Calif.). 11p. (CONF-622-4)

From Institute of Environmental Sciences 1964 Technical Meeting, Philadelphia, Apr. 1964.

The repulsion-coil technique for energy conversion was used in developing a prototype magnetic shock device that uses electrical energy stored in a capacitor bank to produce high-g, mechanical acceleration pulses. A disc projectile is vacuum-held against the core of an electromagnet coil and a crystal accelerometer is attached to the projectile to monitor the pulse. The capacitor bank is charged to a specific voltage between one and 20 kv, then discharged into the coil. The resultant magnetic field around the coil effects a repulsion of the projectile, which is mechanically free to move away from the coil. By varying the capacitor voltage, the magnitude of the pulse can be predicted and controlled. (auth)

Protective Structures

39475 (AD-600752) THE AMERICAN PUBLIC AND THE FALLOUT-SHELTER ISSUE. A NINE-COMMUNITY SURVEY. VOLUME I. A SUMMARY OF METHODS,

FINDINGS, AND IMPLICATIONS. Gene N. Levine and John Modell (Columbia Univ., New York. Bureau of Applied Social Research). May 1964. Contract OCD-OS-62-71. 34p.

A public opinion survey was made on the public's reactions to the Cold War, and especially to throw light on their opinions and actions on the fallout-shelter issue. (auth)

GEOLOGY AND MINERALOGY

General

39476 (NP-14283) A COMPARATIVE STUDY OF THE SHOAL EVENT. Seismic Data Laboratory Report No. 109. Robert Van Nostrand and Wayne Helterbran (United ElectroDynamics, Inc., Alexandria, Va.). Aug. 29, 1964. Contract AF33(657)-12447. 61p.

The SHOAL explosion was for the purpose of comparing seismic data of an explosion with those for an earthquake near the same location, in granite. The SHOAL event is compared with the FALLON earthquake of 20 July, 1962, and also with the HARDHAT event. Teleseismic identification criteria could not be tested as the SHOAL yield was too low, but discriminant criteria based on the relationship between shear and compressional energy in a wave train were confirmed, with the SHOAL and HARDHAT shear-compression ratio being nearly equal at 1.7 and the FALLON ratio being 0.35. (D.L.C.)

39477 (TEI-852) GEOLOGIC MAP OF THE BUCKBOARD MESA QUADRANGLE, NYE COUNTY, NEVADA. F. M. Byers, Jr., C. L. Rogers, and S. J. Luft (Geological Survey, Washington, D. C.). Sept. 1964. 18p.

39478 (TID-21067) THE GEOGRAPHICAL AND VERTICAL DISTRIBUTION OF SEVERAL TRACE ELEMENTS IN SEA WATER (thesis). Geochemistry Technical Report No. 9. Donald Frank Schutz (Yale Univ., New Haven). Apr. 1964. Contract AT(30-1)-2912. 140p.

Methods for the determination of 18 trace elements in sea water by neutron activation analysis were developed. Of these elements sufficient analyses were completed for Au, Se, Sb, Ag, Co, and Ni to permit a discussion of their distributions in the world ocean. The distributions of Au, Se, and Sb are more uniform than those of Ag, Co, and Ni, so little can be said regarding the processes important to their supply to and removal from the world ocean. The variations observed for Ag, Co, and Ni, however, make possible the evaluation of several factors which influence their concentrations in the ocean. The Atlantic Ocean north of 10°S receives 60% of the total dissolved material supplied to the ocean by streams, but is lower in Ag, Co, and Ni than is the remainder of the world ocean indicating that continental run-off is not important in the deep-sea economy of these elements. Relatively high concentrations of Co and Ni are found in water of the central Pacific Ocean in areas where the Co/Mn and Ni/Mn ratios in Mn nodules are high. The evidence that the nodule material in these areas is of volcanic origin may also imply a volcanic origin for the Co and Ni in the overlying water. No such source is indicated for Ag. Unweathered rock material supplied directly to the ocean by Antarctic glaciers seems to be sufficient to affect the silica economy of the ocean and may affect the economy of other trace elements such as Co and Ni which are found to be relatively high in water of Antarctic origin in the South Atlantic. The data are not sufficient, however, to permit an unambiguous interpretation. Co and Ni are relatively low in Long Island Sound compared with the North Atlantic, indicating near-shore removal of these elements from sea water. In the deep sea much of the Co and Ni may be removed by co-precipitation with manganese oxide, but no mechanism seems singularly important in the removal of Ag. Increase in concentration of Ag, Co, and Ni with depth in areas of high organic productivity indicates alteration of trace element concentration by organic reactions. In areas where upwelling currents oppose the downward movement of organic material a relatively high steady state concentration may be produced. (auth)

39479 (TID-21074) GEOCHEMISTRY OF MARINE SEDIMENTS. Karl K. Turekian—J. P. Riley and G. Skirrow, eds. (Yale Univ., New Haven). [1964]. Contract AT(30-1)-1807. 108p.

A discussion of the major features of deep-sea sediment geochemistry is presented. The information is presented in sections on components of deep-sea sediments, radioactive dating and rates of accumulation, trace-element geochemistry in the oceans, and geographical variations. (J.R.D.)

39480 (AEC-tr-6390(p.298-303)) GEOCHEMICAL SIGNIFICANCE OF ISOBARS AND ISOTONES OF STABLE ISOTOPES. A. S. Uklonskii. Translated from Tr. Tashkentsk. Konf. po Mirnomu Ispol'z. At. Energii, Akad. Nauk Uz. SSR, 2: 226-?(1960).

The translocation of chemical elements in hydrotherms in the earth's crust by isobaric and isotonic paragenesis is discussed. A table of the isobaric and isotonic series, with an indication of their paraelements, is presented. Examples of the combination of the combinations of various elements are given. (M.C.G.)

39481 ABUNDANCE OF CHEMICAL ELEMENTS IN THE CONTINENTAL CRUST: A NEW TABLE. S. R. Taylor (Australian National Univ., Canberra). Geochim. Cosmochim. Acta, 28: 1273-85(Aug. 1964).

The rare earth pattern in sedimentary rocks is nearly constant and is considered to represent the relative abundances of these elements in the continental crust. This pattern is derived principally from mixing of basic and acidic igneous rock patterns. Preliminary calculations indicate that approximately equal contributions of basic and acid patterns are required to give the observed rare earth abundance pattern in sedimentary rocks. A table of element abundances in the continental crust, calculated on the basis of a 1:1 mixture of granite and basalt abundances, is presented. Attention is drawn to differences from previous estimates. (auth)

39482 THE COPRECIPITATION OF CATIONS WITH $CaCO_3$. II. THE COPRECIPITATION OF Sr^{+2} WITH CALCITE BETWEEN 90° AND 100°C. H. D. Holland, H. J. Holland, and J. L. Munoz (Princeton Univ., N. J.). Geochim. Cosmochim. Acta, 28: 1287-1301(Aug. 1964).

The distribution of Sr^{2+} between solution and precipitate in calcite and aragonite was measured in precipitates prepared by both the CO_2 introduction and CO_2 release technique. The results are comparable. The value of the distribution coefficient k^C_{Sr} of Sr^{2+} between solution and calcite was found to be 0.076 ± 0.006. The distribution coefficient k^A_{Sr} of Sr^{2+} between solution and aragonite could not be measured precisely, but the values obtained are compatible with those reported previously (0.59 ± 0.02). The value of k^C_{Sr} is independent of both the ionic strength of the solution up to 1.4 m and of the mole fraction of Sr^{2+} in solution. It

is probably also nearly independent of the NaCl concentration in the solutions from which it is precipitated. The value reported can therefore be used to define the ratio $(m_{Sr^{++}}/m_{Ca^{++}})$ in hydrothermal solutions from which calcite has been deposited at 100°C. (P.C.H.)

39483 HAFNIUM CONTENT AND Hf/Zr RATIO IN ZIRCON FROM THE SOUTHERN CALIFORNIA BATHOLITH. David Gottfried and Claude L. Waring. U. S. Geol. Surv. Profess. Papers, No. 501, B88-91(1964).

The hafnium content and the Hf/Zr ratio in zircon indicate a progressive enrichment of hafnium in relation to zirconium from the mafic to the more siliceous rocks. Zircon from the gabbro studied contains 1.0% hafnium and has a Hf/Zr ratio of 0.020. Zircon from the granite has a hafnium content ranging from 1.3 to 2% and Hf/Zr ratios ranging from 0.027 to 0.040. Within the rocks of a single stock of Woodson Mountain granodiorite, hafnium, and the Hf/Zr ratio are highest in the zircon of finest mesh sizes. (auth)

39484 DISTRIBUTION OF BERYLLIUM IN IGNEOUS ROCKS. Daniel R. Shawe and Stanley Bernold. U. S. Geol. Surv. Profess. Papers, No. 501, B100-4(1964).

Beryllium concentration in igneous rocks tends to increase with increase in silica content, but reaches a maximum in rocks containing less-than-maximum amounts of silica. Among rocks having alkalic and silicic compositions, plutonic types normally contain the greatest average amount of beryllium, hypabyssal types an intermediate amount, and volcanic types the smallest amount. (auth)

Natural Radioactivity and Fallout

Refer also to abstract 38993.

39485 (CONF-337-43) STRATOSPHERIC FALLOUT OF BOMB-PRODUCED CERIUM ISOTOPES AND ATMOSPHERIC FRACTIONATION OF NUCLEAR DEBRIS. P. K. Kuroda, K. K. Menon, and B. D. Palmer (Arkansas. Univ., Fayetteville). [1963]. Contract AT(40-1)-2529. 21p.

From International Conference on Radioactive Pollution of Gaseous Media, Saclay, France, Nov. 1963.

Levels of ^{141}Ce, ^{143}Ce, and ^{144}Ce in individual samples of rain and snow have been measured radiochemically at Fayetteville, Arkansas, during the past few years. The data are compared with the ^{89}Sr, ^{90}Sr, and ^{140}Ba data also obtained at Fayetteville, Arkansas. The concentrations of both radiocerium and radiostrontium show a marked seasonal variation with a peak in the spring and a minimum in the fall. During a nuclear test suspension period, the $^{141}Ce/^{144}Ce$ ratios in a series of rainfalls can be expressed as a simple function of the decay constants of ^{141}Ce and ^{144}Ce and the time elapsed since the cessation of the nuclear test series. The $^{89}Sr/^{90}Sr$ ratio data, however, tend to deviate from such a theoretical equation and show a considerable scatter of experimental points. The $^{144}Ce/^{90}Sr$ ratio data, on the other hand, can not be expressed as a simple function of the decay constants and time. These results are tentatively explained as due to the effects of fractionation of the bomb-produced fission products in the atmosphere. (auth)

39486 (CONF-337-44) INVENTORIES OF SELECTED LONG-LIVED RADIOISOTOPES PRODUCED DURING NUCLEAR TESTING. L. Machta, R. J. List, and K. Telegadas (Weather Bureau, Washington, D. C.). Nov. 1963. 29p.

From International Conference on Radioactive Pollution of Gaseous Media, Saclay, France, Nov. 1963.

Inventories are presented on long-lived radioisotopes in the atmosphere over the period 1958 to 1963. The radioisotopes are ^{90}Sr, ^{185}W, ^{102}Rh, and ^{14}C, and the inventories are based on both high-altitude and ground observations. The uncertainties in the data are discussed. The ^{90}Sr produced from the USSR nuclear tests is estimated. (D.L.C.)

39487 (HASL-145) ENVIRONMENTAL RADIATION MEASUREMENTS IN THE SOUTHEASTERN, CENTRAL AND WESTERN UNITED STATES, 1962-1963. Harold L. Beck, William J. Condon, and Wayne M. Lowder (New York Operations Office. Health and Safety Lab., AEC). Apr. 1964. 38p.

A NaI(Tl) detector and a high pressure ionization chamber were used to obtain gamma ray spectra and total gamma dose rates at approximately 100 locations during the course of several survey trips in the southeastern, central, and western United States. Reasonably precise estimates of the dose rates from each of the individual components of both the natural and fallout gamma fields are made using the pulse height spectra and relatively simple methods of analysis. The equipment and types of locations surveyed are discussed briefly and the methods used for determining component and total dose rates from the pulse height spectra are summarized. The total terrestrial dose rates as well as the partial dose rates from the uranium-238 series, thorium-232 series, potassium-40, zirconium-niobium-95, and rhodium-106 are tabulated for each location. Particular results of interest with respect to environmental gamma radiation, effects of precipitation on fallout gamma dose rates, and the validity of the spectral analysis methods are discussed. Among these results are the relatively high natural dose rate levels in the Denver, Colorado area and the correlation between fallout gamma dose rates and mean annual rainfall for several sites on the Olympic Peninsula, Washington. (auth)

39488 (NP-14127) THE MEASUREMENT OF DISSOLVED SILICON-32 IN SEA WATER. David Regier Schink (Scripps Institution of Oceanography, San Diego, La Jolla, Calif.). Aug. 1962. Contract AF19(604)-4567. 192p.

Thesis submitted to Univ. of California, San Diego, La Jolla.

A second radioisotope, supplementing carbon-14, would be useful for studies of deep ocean circulation. Silicon-32, an isotope of appropriate half life for such studies, is produced in the atmosphere by cosmic rays and is carried to the ocean by precipitation. In the ocean the ^{32}Si is diluted by stable silicon, but the activity may be observed by separating the radioactive daughter, phosphorus-32, from the silicon and measuring the phosphorus activity. To furnish a useful tool for oceanographic research a method of measurement was developed. A 30 ton water sampler was developed using a self-filling flexible bag. An extraction system for removing dissolved silica from sea water was built. Geiger counters of very low background were designed and constructed to count the activity obtained. Four samples were taken: two from approximately 1000m depth of 1.4×10^4 and 1.9×10^4 liters, respectively; one from about 2500m of 4×10^4 liters; and a surface sample of 24×10^4 liters. The silicon was extracted and purified and the phosphorus activity extracted, purified, and counted. The observed activity is about 210 dpm/kg Si at the surface, 12 dpm/kg Si at 1000m, and 6 dpm/kg Si at 2500 m. These values are surprisingly

high compared with activities previously determined by Lal et al., in sponges from the ocean's mixed layer. The observed activity per volume of sea water is lower at the surface than at 1000m, and lower at 2500m than at 1000m. This suggests that surface silicon is being delivered to the intermediate depth by some mechanism, presumably the resolution of diatoms. (auth)

39489 (NP-14317) ZENTRALANSTALT FUR METEOROLOGIE UND GEODYNAMIK IN WIEN. (Three-Hourly Measurements of Radioactivity of the Near Ground Atmosphere in 1964). (Austria. Zentralanstalt fur Meteorologie und Geodynamik, Vienna). 20p.

Results of measurements of the radioactive impurities in the air at Vienna from January to June, 1964, are presented in tables. (M.C.G.)

39490 (NRS-17) RADIOCHEMICAL ANALYSES FOR ^{90}Sr, ^{137}Cs, ^{226}Ra AND ^{40}K IN NATURAL AND PROCESSED MATERIALS IN AUSTRALIA. J. H. Green and E. T. Pallister (New South Wales, Australia. Univ., Kensington). 1964. 14p.

Data are presented on the ^{90}Sr, ^{226}Ra, and ^{40}K contents in tea, coffee, cigarettes, and bone meal tablets, and on the ^{90}Sr and ^{137}Cs contents of rain which fell in 1962 to 1964. (D.L.C.)

39491 STUDIES OF THE FALLOUT RADIOACTIVITY OF GROUND-LEVEL AIR, PRECIPITATION AND DUST AT STUTTGART-HOHENHEIM. W. Rentschler, W. Haeussermann, and P. H. Wieser (Landwirtschaftliche Hochschule, Stuttgart). Atomkernenergie, 9: 297-306(July-Aug. 1964). (In German)

The results of an investigation of the deposition of radioactive fallout at Stuttgart-Hohenheim from April 1961 to December 1963 are discussed. Dry and precipitation fallout samples were radiochemically analyzed for ^{90}Sr and γ spectrometrically examined. Fractionation phenomena caused by meteorological influences and different sampling devices were studied. (auth)

39492 TOTAL BETA ACTIVITY IN GLOBAL FALLOUT IN AUSTRALIA DURING 1963. R. J. L. Alsop, W. J. Gibbs, J. R. Moroney, D. J. Stevens, and E. W. Titterton (Atomic Weapons Test Safety Committee, Australia). Australian J. Sci., 26: 342-5(May 1964).

Continuous sampling of fallout of measurement of total beta activity was maintained throughout 1963 in Australia. All stations exposed gummed films continuously to provide daily samples. Stainless steel pots were also exposed continuously and emptied at the end of each month. The samples were evaporated to dryness and measured for total beta activity. Levels of measured activity were notably lower than in 1962 and toward the end of 1963 were approaching those observed prior to the resumption of nuclear weapons testing in September 1961. (M.C.G.)

39493 STRONTIUM-90 IN THE AUSTRALIAN ENVIRONMENT DURING 1962. F. J. Bryant (Atomic Energy Research Establishment, Woolwich Outstation, Eng.), W. J. Gibbs, J. R. Moroney, D. J. Stevens, and E. W. Titterton. Australian J. Sci., 27: 1-6(July 1964).

During 1962, 1,815 specimens of precipitation, soil, milk, cabbages, flour, and human and sheep bone tissue were collected in Australia for ^{90}Sr analysis. It was found that the mean annual deposition of ^{90}Sr in precipitation remained in the region of 1 mC/km^2/annum from 1956 to 1962. Data from all analyses are presented in tables. The mean daily per capita intake of ^{90}Sr in diet in Australia was estimated from the measurements on foodstuffs. A slow increase in the levels of ^{90}Sr in Australian human bone tissue of all ages was observed by comparing data for 1962 with that accumulated in 1958 to 1961. Measurements of ^{90}Sr in sheep bone tissue indicated an increase of 20 to 30% in the level of ^{90}Sr per gram of calcium since 1961. (M.C.G.)

39494 CARBON–OXYGEN ISOTOPIC COMPOSITION OF FLAGSTAFF CARBONATE ROCKS AND ITS BEARING ON THE HISTORY OF PALEOCENE-EOCENE LAKE FLAGSTAFF OF CENTRAL UTAH. J. N. Weber (Pennsylvania State Univ., University Park). Geochim. Cosmochim. Acta, 28: 1219-42(Aug. 1964).

The carbon and oxygen isotopic composition of freshwater dolomitic and calcitic carbonate rocks and of calcitic molluscs from the Flagstaff formation (Paleocene–Eocene) of central Utah is consistent with the three-phase depositional history proposed by Spieker (1949) on the basis of stratigraphic relations and lithology. The isotopic data are also consistent with the hypothesis that the middle Flagstaff unit derived its evaporitic nature from the influx of soluble material from Jurassic salt beds. Penecontemporaneous, or very early diagenetic dolomitization of the fine-grained calcite ooze with probable oxygen isotopic equilibration between calcite and dolomite is indicated. Carbon isotope ratios suggest increasing influx of streamborne sediments in the last stage of Lake Flagstaff. (auth)

39495 CARBON ISOTOPE RATIOS IN DOLOSTONES: SOME IMPLICATIONS CONCERNING THE GENESIS OF SECONDARY AND "PRIMARY" DOLOSTONES. J. N. Weber (Pennsylvania State Univ., University Park). Geochim. Cosmochim. Acta, 28: 1257-65(Aug. 1964).

Ratios of $^{12}C/^{13}C$ in conjunction with aluminum and chloride ion contents of some Paleozoic dolostones suggest that some of the fine-grained, so-called primary dolostones may have originated in areas receiving appreciable terrestrial detrital material, whereas other fine-grained dolostones originated in evaporitic basins. Coarse-grained, so-called secondary dolostones appear to have formed in normal marine environments where conditions of normal salinity and low clay mineral content permitted the formation of bioclastic limestones. (auth)

39496 ON URANIUM, THORIUM AND POTASSIUM DISTRIBUTION IN HOMOGENEOUS GRANITES. L. L. Leonova and O. S. Renne (Vernadskii Inst. of Geochemistry and Analytical Chemistry, Moscow). Geokhimiya, No. 8, 788-94(1964). (In Russian)

In leucocratic granites of the Hantaus massif thorium, uranium, and potassium are uniformly distributed and their contents are 20.8, 2.4, and 3.26 γ/g, respectively; 50 to 60% of the total uranium and 36% of thorium of the rocks are concentrated in rock-forming minerals and only 30% of uranium and 50% of thorium are connected with accessory minerals. (auth)

39497 REGULARITIES OF URANIUM MIGRATION IN NATURAL WATERS OF HUMID AREAS AND THEIR USE IN THE DETERMINATION OF HYDROCHEMICAL BACKGROUND OF URANIUM. A. P. Lopatkina. Geokhimiya, No. 8, 802-10(1964). (In Russian)

The conditions of uranium migration in waters of igneous rocks in areas with a humid climate were studied. It was established that in conditions of a humid climate the uranium content in waters of igneous rocks is determined by its concentration in rocks and the quantity of dissolved rock. The interdependence between these values may be expressed by the formula $m_U = (2n_U \cdot \alpha/100)$, where m_U

is the uranium content in water in g/l, n_U is the uranium content in the rock in percents, and α is the magnitude of the general mineralization in g/l. The coefficient 2 is the most probable coefficient of uranium migration that was found for the studied conditions. The dependence that was established may be used for the determination of the background values of uranium in waters. (auth)

39498 RADIOACTIVE FALLOUT IN CALIFORNIA DURING THE WINTER 1961-2. Paul Kruger, Gerald Hamada, and Albert Miller (Hazleton-Nuclear Science Corp., Palo Alto, Calif.). J. Appl. Meteorol., 2: 608-13(Oct. 1963).

Collections of nuclear debris in dry and precipitation fallout samples were made during the winter 1961-62 at Palo Alto and Santa Barbara, Calif., following resumption of nuclear testing by the USSR. The samples were radiochemically analyzed for the fallout radionuclides ^{90}Sr and ^{89}Sr. The data showed the expected increase in radioactivity levels at each location in precipitation following the Soviet detonations. Palo Alto and Santa Barbara, separated by 300 miles, exhibited close similarity in fallout results. Two changes in fallout concentrations were observed that may be attributed to meteorological influences. (auth)

39499 REMARKS ON THE THORON CONTENT OF THE ATMOSPHERE. H. Israeel (Technische Hochschule, Aachen). J. Atmospheric Terrest. Phys., 26: 787-9(July 1964).

The discrepancy between the predicted thoron content of atmospheric air near the ground and the content as determined from measurements of ThB content is explained in terms of the inadequacy of the usual assumption of radioactive equilibrium between thoron and ThB. Two measurement methods that avoid this difficulty are described. (D.C.W.)

39500 EXTERNAL DOSES OF RADIATION FROM FALL-OUT IN TOKYO AND ITS VICINITY. Fumio Yamasaki (Inst. of Physical and Chemical Research, Tokyo), Masaharu Okano, Teruaki Nagahara, and Hironobu Watanabe. J. Radiation Res. (Japan), 5: No. 2, 1-3(1964). (A/AC.82/G/L.952)

External doses of radiation from fallout materials deposited on the ground were observed in three different places in Tokyo and its vicinity. Scintillation counters and ionization chambers were used as radiation detectors. Monthly doses observed over six years revealed that external radiations mostly come from nuclides with intermediate half lives. Their values exceeded the level of dose rate due to natural radioactive substances for the period of 22 months beginning October 1961. (auth)

39501 RADIOACTIVITY IN MAN'S DIET. R. Scott Russell and E. R. Mercer. p.42-57 of "Radiation Levels. Air, Water and Food." London, The Royal Society of Health, 1964.

If man-made radioactive substances escape into the atmosphere and are deposited on agricultural land, iodine-131, strontium-89, strontium-90, and cesium-137 are likely to be the main sources of radiation to man as a result of the contamination of his diet. The effects of inhalation and the contamination of drinking water would be minor by comparison. Measurements of the total radioactivity in the environment are inadequate for assessing the resultant tissue doses. If the diet is of European type, milk is the major source of iodine-131 and the isotopes of strontium; meat, in addition to milk, is important for cesium-137. Measurements of the radioactivity in these foods will often enable the overall exposure from these nuclides to be estimated. Aquatic foods contribute little to the total contamination of diet, except when discharges occur directly into water. This situation can result in limited areas as a result of the discharges of effluent from nuclear establishments. Hitherto, the radiation doses resulting from the contamination of diet throughout the United Kingdom have been considerably below the limits set by the Medical Research Council. The comparison of these doses with those simultaneously received by the population from natural background and medical diagnosis can give perspective to the discussion of environmental contamination. (auth)

39502 EVALUATION OF THE ATMOSPHERIC RADIOACTIVITY IN CZECHOSLOVAKIA IN 1963. P. Petrovic. Meteorol. Zpravy, 17: No. 3, 88-93(June 1964).

Presented are data on the atmospheric radioactivity, including data on the monthly, weekly, and daily fallout in 1963. Relations between extremes of radioactivity and temperature and wind are discussed. (OTS)

39503 FALL-OUT IN LONDON RAIN WATER. R. Wood, P. Metson, and L. A. Richards (Dept. of Scientific and Industrial Research, London). Nature, 203: 617-19 (Aug. 8, 1964).

Regular samples of London rainwater were analyzed for radionuclide content following the resumption of nuclear testing in 1961. During the period reviewed, the main contributors to radioactivity in rain were ^{90}Sr, ^{137}Cs, ^{144}Ce, and ^{147}Pm. (H.M.G.)

39504 ISOTOPIC COMPOSITION OF LEAD AND STRONTIUM FROM ASCENSION AND GOUGH ISLANDS. Paul W. Gast (Univ. of Minnesota, Minneapolis), G. R. Tilton, and Carl Hedge. Science, 145: 1181-5(Sept. 11, 1964).

Isotopic composition of lead and strontium was determined in a series of rock samples from two islands on the Mid-Atlantic Ridge. Both inter- and intra-island variations exist in the abundance of radiogenic isotopes of both elements. Lead from basalt of Ascension Island has a $^{206}Pb-^{204}Pb$ ratio of 19.5, while the corresponding ratio at Gough Island is only 18.4. The $^{208}Pb-^{204}Pb$ ratios from the two islands do not differ. Conversely, strontium from basalt of Ascension Island is less radiogenic than that from Gough Island basalts. The trachytes of both islands have lead and strontium that is more radiogenic than that found in the basalts. The inter-island differences indicate the existence of regional variations in the uranium-lead and rubidium-strontium ratios of the upper mantle source of these rocks and show that isotope compositions are a means for investigating chemical heterogeneities in the mantle. (auth)

39505 STRONTIUM 90: ESTIMATION OF WORLD-WIDE DEPOSITION. Herbert L. Volchok (Atomic Energy Commission, New York). Science, 145: 1451-2(Sept. 25, 1964). (TID-19202)

The relation between the worldwide deposition of ^{90}Sr, as calculated by many investigators over the last decade, and that observed in rainfall in New York City has been relatively constant. On the average, for each millicurie of ^{90}Sr per square mile deposited in New York City, 0.055 megacurie was deposited on the earth's total surface. Cumulative deposits of ^{90}Sr on the earth's surface at various intervals over the last 10 years have been computed from this ratio. From the mean quarterly fraction

of the annual ^{90}Sr fallout in New York City for the last 9 years, the worldwide deposition of this nuclide, equal to 2.48 megacuries, is predicted for 1964. (auth)

39506 GAMMA SPECTROMETRIC STUDIES OF RADIOACTIVE FALLOUT AND QUANTITATIVE MEASUREMENT OF A HOT PARTICLE. K. F. Poulheim (Institut fur Staubforschung und Radioaktive Schwebstoffe, Berlin). Symp. Tech. Zagadnien Ochrony Promieniowaniem, Warsaw, 186-95(1962). (In German)

The measurement of rain and filter ash samples using a gamma scintillation spectrometer and the methods used for the quantitative determination of the activity of the isotope are reported. In the rain samples, the maximum permissible concentration for an unknown β-γ emitting mixture in water was surpassed. The analysis showed, however, that for the individual isotopes $^{141}Ce-^{144}Ce$, ^{103}Ru, and $^{95}Zr-^{95}Nb$ the content did not exceed the maximum permissible concentration in water. In the filter ash samples, all measured values were below the maximum permissible concentration in air. Measurements on a radioactive particle that was found on the filter of an air monitor are discussed. The particle was autoradiographed, qualitatively and quantitatively determined, and theoretically analyzed for its dose output in biological tissue. The particle arose from $^{144}Ce-^{144}Pr$ and had an activity of 2×10^{-3} μC. A theoretical estimation of the minimum size (without carrier) of the particle gave a diameter of ≥ 0.4 μ. A dose output of 1700 rad/hr was obtained from the particle at a distance of 10^{-3} cm in biological tissue. (tr-auth)

39507 FOOD CONTAMINATION IN POLAND IN 1959-1961. R. Szepke, J. Bilkiewicz, and Z. Malinowski (Central Laboratory for Radiological Protection, Warsaw). Symp. Tech. Zagadnien Ochrony Promieniowaniem, Warsaw, 196-203(1962). (In Polish)

The results of measurement of the total activity of milk, meat, cheese, and fish in Poland are presented in graphs and tables. Although the results are difficult to interpret, a correlation between food and environmental activity is indicated. A significant decrease of the activity in 1959-1960 and an increase at the end of 1961 were detected. (tr-auth)

39508 STRONTIUM-90 CONTENT OF FOOD IN POLAND 1960-1961. W. Czosnowska (Inst. for Labor Medicine, Radiological Protection Establishment, Lodz, Poland). Symp. Tech. Zagadnien Ochrony Promieniowaniem, Warsaw, 213-23(1962). (In Polish)

In order to determine the ^{90}Sr contamination of food in Poland, Ca-rich foods, such as milk, potatoes, meal, cabbage, and peas, were investigated. The milk samples were systematically collected monthly from zones according to the precipitation. Powdered milk was also tested. On the basis of the results obtained, and additional statistics on the food consumption, the average consumption of ^{90}Sr with food was calculated. (tr-auth)

39509 RADIOCHEMICAL METHODS FOR BULK CONTROL OF STRONTIUM-90 CONTENT IN FRESH WATER. G. A. Sereda and Ts. I. Bobovnikova (Inst. of Applied Geophysics, Academy of Sciences, USSR). Symp. Tech. Zagadnien Ochrony Promieniowaniem, Warsaw, 223-34(1962). (In Russian)

For estimation of the degree of contamination of the environment with radioactive fallout, and for the control of the migration of radioisotopes in the biosphere, data on the radioiostope concentration in water reservoirs are of great importance. The control of the ^{90}Sr content in reservoirs is the most significant. Monitoring for this isotope was carried out in all large rivers, seas, and artificial reservoirs. The water samples were collected periodically so that representative samples were obtained for summer, winter, and spring. Both the presence of an extensive net of sampling sites and the execution of a large number of radiochemical ^{90}Sr determinations are necessary in order to obtain a complete picture of the water contamination. The organization of such a monitoring system is more difficult by the necessity of determining very small concentrations of ^{90}Sr, of the order of 10^{-12} to 10^{-13} c/l. Therefore, large samples, 15 to 20 l, were necessary. Since the usual radiochemical methods are complicated and time-consuming, the mass determination of ^{90}Sr is much more difficult. A simple method for the determination of ^{90}Sr in fresh water and a proposal for the organization of water sampling and execution of the determinations are described. (tr-auth)

39510 STUDY OF GAMMA RADIOACTIVITY IN CERTAIN BUILDING MATERIALS. J. Pensko and M. Bysiek (Central Laboratory for Radiological Protection, Warsaw). Symp. Tech. Zagadnien Ochrony Promieniowaniem, Warsaw, 235-46(1962). (In Polish)

The investigations of the natural γ activity in building materials were carried out with scintillation measurement methods. The scintillation tip ECCO N 664 was used with a decade counter and a 200-channel scintillation spectrometer for the measurements. The results showed that the radioactivity of blast furnace slag and flue dust is somewhat higher than that of other building materials. The lowest gamma activity of the materials studied was found in lime, sand, glass, and gypsum. (tr-auth)

Site Survey and Selection

39511 (WT-1869) IN SITU STRESSES IN ROCK, RAINIER MESA, NEVADA TEST SITE. Leonard Obert (Bureau of Mines. Applied Physics Research Lab., College Park, Md.). Apr. 1964. Operation NOUGAT and STORAX. 106p.

Results of an investigation are presented to confirm stress measurements previously made in tunnels G, B, E, P, and N for Madison and Yuba events, to determine the mechanical properties of the rock from these tunnel sites, and to prepare analysis reports based on these data. Summaries of mechanical property and stress measurements are included. (J.R.D.)

39512 REACTOR SITING. L. H. McEwen (General Electric Co., San Jose, Calif.). Toronto, Canadian Nuclear Assn., 1964, Preprint 64-CNA-116, 11p. (CONF-539-13)

From Canadian Nuclear Association Conference on Canada's Role in a World of Expanding Nuclear Industry, Toronto, May 1964.

Technical and public-acceptance aspects of reactor siting are discussed, with particular reference to practices in the U.S.A. (T.F.H.)

Techniques and Equipment

39513 (AEC-tr-6390(p.290-7)) RADIOMETRIC APPARATUS USED IN PROSPECTING FOR OIL AND GAS. A. P. Grumbkov and G. S. Semenov. Translated from Tr. Tashkentsk. Konf. po Mirnomu Ispol'z. At. Energii, Akad. Nauk Uz. SSR, 2: 220-?(1960).

Equipment was developed for radiometric prospecting

for oil and gas. Radiometers were set up in both automobiles and planes and their sensitivities determined. (M.C.G.)

39514 (AEC-tr-6390(p.304-21)) USE OF THE RADIOACTIVE TRACER METHOD TO STUDY PROBLEMS OF THE TRANSLOCATION OF WATER IN THE PEAT STRATUM DURING DRAINAGE. M. P. Volarovich and N. V. Churaev. Translated from Tr. Tashkentsk. Konf. po Mirnomu Ispol'z. At. Energii, Akad. Nauk Uz. SSR, 2: 230-?(1960).

Methods using radioactive tracers for the investigation of water translocation in peat beds, the infiltration of atmospheric precipitation, and the work of drainage setups are described. ^{35}S, ^{131}I, ^{82}Br, and ^{3}H were considered as tracers. Wells were sunk in the peat and the radioisotope introduced into the wells. The variations of tracer concentrations in the wells were studied. (M.C.G.)

39515 (AEC-tr-6390(p.322-38)) STUDY OF THE WATER PROPERTIES, STRUCTURE, AND PROCESSES OF MOISTURE TRANSFER IN PEAT USING LABELLED ATOMS. N. V. Churaev. Translated from Tr. Tashkentsk. Konf. po Mirnomu Ispol'z. At. Energii, Akad. Nauk Uz. SSR, 2: 243-?(1960).

Radioactive tracers were used to study the water properties, structure, and processes of the translocation of moisture in peat. ^{35}S was used as the tracer. Methods were developed for determining immobilized water in peat, the content on nondissolving water, the forms of the bond of water to peat, moisture transfer mechanisms, isothermal drying processes, and the capillary rise of water in peat monoliths. (M.C.G.)

39516 (AEC-tr-6390(p.355-64)) APPLICATION OF NEUTRON ACTIVATION ANALYSIS TO GEOLOGY. D. I. Leĭpunskaya, R. A. Rezvanov, and V. I. Dryŋkin. Translated from Tr. Tashkentsk. Konf. po Mirnomu Ispol'z. At. Energii, Akad. Nauk Uz. SSR, 2: 269-?(1960).

Advantages of the method of neutron activation analysis for use in geological investigations are discussed and examples of its use are described. The determination of Na and K in samples of rocks by neutron activation is discussed. (M.C.G.)

39517 (AEC-tr-6390(p.365-71)) NEUTRON MULTIPLIER FOR ACTIVATION ANALYSIS OF GEOLOGICAL SAMPLES. T. A. Lopovok. Translated from Tr. Tashkentsk. Konf. po Mirnomu Ispol'z. At. Energii, Akad. Nauk Uz. SSR, 2: 277-?(1960).

A high-power portable neutron multiplier was designed for use in activation analysis of geological samples. The neutron multiplier is a subcritical uranium-water heterogeneous system mounted on a car. The initial neutron flux is given by a Po–Be source. The fuel elements are rods of uranium, enriched up to 10%, mixed with magnesium and contained in an aluminum tube. (M.C.G.)

39518 NOTE ON ISOTOPIC CHANGES INDUCED BY COSMIC RAYS IN THE EARTH'S CRUST. Rama (Tata Inst. of Fundamental Research, Bombay). Bull. Natl. Geophys. Res. Inst. (India), 1: 241-2(1963).

The possibility of using studies of isotopic changes produced in rocks due to interactions of cosmic rays for investigating the rates of vertical movements and of erosion of rocks during geological periods is discussed. (auth)

39519 AGE DETERMINATION OF KOROSTENSK GRANITES AND DNEPROVSK MIGMATITES AND METABASITES OF THE UKRAIN BY THE Rb–Sr METHOD ON ROCKS AS A WHOLE. I. M. Gorokhov (Laboratory of the Geology of Precambrian, Leningrad). Geokhimiya, No. 8, 744-53(1964). (In Russian)

With the aid of the Rb–Sr isochrone method the ages of two rock complexes of the Ukrainian crystalline shield were determined. The age of the Korostensk granites equals 1720 ± 70 million years. The probable interval for the age of Dneprovsk migmatites and the xenoliths of metabasites included in them is 2550 to 3950 million years. (auth)

39520 ON THE AGE OF KARELIAN FORMATION. E. V. Bibikova, A. I. Tugarinov, S. I. Zykov, and G. L. Melnikova (Vernadskii Inst. of Geochemistry and Analytical Chemistry, Moscow). Geokhimiya, No. 8, 754-7 (1964). (In Russian)

Results of age determinations by the Pb–U method are reported for the basal conglomerates of the Yatulian formation and for zircons from the post lower karelian granites. The results show that the beginning of sedimentation of the Middle Proterozoic rocks in Karelia was about 1800 million year ago. The upper limit for the lower karelides on the weathered surface of which lay yatulian conglomerates is 2850 ± 150 million years. (auth)

39521 NEUTRON CAPTURE GAMMA-RAY SPECTROSCOPY FOR THE EXPLORATION OF IRON-BEARING ORES IN BOREHOLES. W. Loetzsch (I Physikalisches Institut der Bergakademie, Freiberg i. B.). Kernenergie, 7: 560-7(June-July 1964).

Some experimental results of neutron capture gamma spectroscopic measurements with a single-crystal scintillation spectrometer on pure elements and rock samples for the exploration of iron-bearing ores are presented and results of neutron capture gamma spectroscopic borehole measurements of some iron-bearing ore deposits are reported. (auth)

39522 T-PHASE OF MAY 11, 1962, RECORDED IN HAWAII. Harold L. Krivoy and Robert A. Eppley (Hawaiian Volcano Observatory and Honolulu Observatory, Hawaii). U. S. Geol. Surv. Profess. Papers, No. 501, B105-7(1964).

An underwater nuclear explosion on May 11, 1962, generated a T-phase that was felt by coastal residents of Hawaii. It was also recorded throughout the State by 12 short-period seismometers. From the times of the T-phase maxima at seismographs on Hawaii, Maui, and Oahu the azimuth from the Hawaiian Islands to the source of the T-phase could be roughly calculated. (auth)

39523 EFFECTS OF THE GNOME NUCLEAR EXPLOSION UPON ROCK SALT AS MEASURED BY ACOUSTICAL METHODS. D. D. Dickey. U. S. Geol. Surv. Profess. Papers, No. 501, B108-11(1964).

An attempt was made to measure, by acoustical methods, changes in physical properties of rock salt at the Gnome site, New Mexico, which were caused by the detonation of a nuclear device. Longitudinal and shear velocities of rock in place were measured before and after the explosion. Postexplosion velocities were slower, owing to fracturing of the rock, for a distance of more than 200 feet from the shot point. Various elastic constants were calculated for the rock salt before and after the blast, using the measured velocities. (auth)

Thorium and Uranium Minerals

39524 EPITAXIAL TRANSFORMATION $U_3O_8 \rightarrow UO_{2+x}$ IN PITCHBLENDES. Yu. M. Dymkov. Dokl. Akad. Nauk SSSR, 157: 583-5(July 21, 1964). (In Russian)

It was proposed that pitchblende was first deposited as U_3O_8 which transforms to a metamict mineral by reduction: $U_3O_8 \rightarrow U_4O_9 \rightarrow UO_{2+x}$. The lattice constants and structures are compared for U_3O_8, $U_3O_7(\alpha\text{-}U_3O_7)$, and UO_2 in order to show that epitaxial growth is possible amongst these compounds during reduction. These ideas of epitaxial growth agree with the metallographic data on pitchblende spherulites. Laue diagrams of pitchblende indicate the existence of ordered spherulites (UO_2 filaments) and disordered inclusions. Etching with nitric acid of the polished pitchblende specimen showed up the granular structure of the filaments in the UO_2 spherulites. The crystallites in the filaments consists of two uranium oxides which differ in the degree of reduction. The epitaxial replacement $U_3O_8 \rightarrow UO_{2+x}$ takes place in stages with formation of an intermediate metastable oxide (U_2O_5 or U_3O_7). Thus, pitchblende can be distinguished from uraninite in that pitchblende was first deposited as a non-cubic mineral in the form of U_3O_8, and then was converted by stages epitaxially to UO_{2+x}. Uraninite, on the other hand, crystallizes as a cubic mineral in the form of U_4O_9 ($\rightarrow UO_{2+x}$) or UO_2. (TTT)

39525 FRACTIONATION OF URANIUM ISOTOPES AND DAUGHTER PRODUCTS IN WEATHERED GRANITE AND URANIUM-BEARING SANDSTONE, WIND RIVER BASIN REGION, WYOMING. J. N. Rosholt, E. L. Garner, and W. R. Shields (National Bureau of Standards, Washington, D. C.). U. S. Geol. Surv. Profess. Papers, No. 501, B84-7 (1964).

Isotopic ratios of $^{238}U/^{234}U$ for three samples representing different stages of weathering of granite show 7 to 23% deficient ^{234}U. The slightly weathered rock is most deficient, suggesting major ^{234}U leaching at an early stage in the decomposition. Isotopic ratios in samples from a uranium deposit in sandstone showed slight excess ^{234}U in unoxidized sandstone and up to 72% excess ^{234}U in parts of the adjoining oxidized standstone characterized by relatively high uranium content. $^{230}Th/^{234}U$ ratios indicate relatively recent deposition of redistributed uranium in parts of the oxidized sandstone where the $^{234}U/^{235}U$ ratio is high. The low $^{234}U/^{235}U$ ratios prevailing in uranium-poor parts of the oxidized sandstone are believed to have resulted from preferential leaching of ^{234}U in these places and over a considerable time. (auth)

HEALTH AND SAFETY

Refer also to abstracts 39704, 39705, 39830, and 40749.

39526 (AD-600759) ENVIRONMENTAL INSTRUMENT PACKAGE FOR A CIVIL DEFENSE SHELTER. Summary of Research Report. (Thomas A. Edison Research Lab. Div. of McGraw-Edison Co., West Orange, N. J.). May 1964. Contract OCD-OS-62-216. 6p.

The environmental variables that need monitoring are temperature, relative humidity, differential pressure, and concentrations of various gases. The tolerance levels and instrument design ranges for these variables are outlined. Several instrument packages have been evaluated, and recommendations are given for revisions of existing equipment. (D.L.C.)

39527 (AD-603216) LOCAL CIVIL DEFENSE SYSTEMS. A STUDY OF COUNTERFORCE DEFENSE SYSTEMS METHODOLOGY APPLIED TO TUCSON, ARIZONA AND ENVIRONS. Final Report. (Arizona. Univ., Tucson. Engineering Research Lab.). June 4, 1964. Contract OCD-OS-62-232. 180p.

Procedures and methodologies necessary to evaluate local nuclear-attack hazards are presented and the results are applied to target cities; specifically, Tucson, Arizona, and environs. The design concepts which have evolved from consideration of conceivable constraints (developed from the evaluations) are presented in general form. Particular concepts which appear to be most realistic, in light of economic factors, are described in greatest detail. Training requirements are outlined for the most desirable concept. Technical material in substantial detail is included. (auth)

39528 (APED-4522) DESTRUCTIVE DROP TESTS OF A MODEL FUEL-SHIPPING CASK. G. L. Saywell (General Electric Co. Vallecitos Atomic Lab., San Jose, Calif.). Apr. 15, 1964. 32p. (64-APE-7)

Deactivation of the Vallecitos Boiling Water Reactor brought about a need for a shipping cask that could accommodate 54-in.-long irradiated fuel elements. The 40-in. cavity of the existing 700-series shipping casks could be lengthened by using a simple spool-piece. The results of a stress analysis of the modified cask showed that the conditions of code of Federal Regulations #10CFR72 (proposed) would be met. To verify this conclusion, a one-quarter-size model was made and dropped twice from a height of 15 ft onto an unyielding surface. Although deformation occurred, the cask retained structural integrity. (auth)

39529 (CONF-337-5) GASEOUS EFFLUENT STUDIES AND AIR CLEANING ACTIVITIES IN THE UNITED STATES ATOMIC ENERGY INDUSTRY. David C. Costello, Jr. (Division of Reactor Development, AEC). [1963]. 51p.

From International Conference on Radioactive Pollution of Gaseous Media, Saclay, France, Nov. 1963.

A review is presented of the AEC program of the removal from air of radioactive particulates which are produced by the various AEC nuclear energy activities. The production and control of gaseous wastes in the nuclear fuel cycle, fuel reprocessing, laboratories, mobile power reactors, etc. are discussed. The AEC research and development program on meteorology and air cleaning in gaseous waste control operations is described. (D.L.C.)

39530 (HW-SA-3631) SAFETY CONTROL PROGRAM. [W. O. Goslin] (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). [July 23, 1964]. Contract [AT(45-1)-1350]. 6p. (CONF-670-1)

From Annual AEC Meeting on Industrial Safety and Fire Protection, Idaho Falls, Idaho, July 1964.

A statistical sampling plan is described that is designed to monitor the average safety performance level of an operating group, area, or plant. The system uses both random sampling and control charts, and measures employee attitude and accident potential through the medium of looking for unsafe acts and unsafe conditions in a plant. The principle can be applied at any level and the specific form and mechanics of the program is determined by the organizational level at which management control is exercised. Applications are described for a nuclear fuels manufacturing plant accumuoating approximately 1,000,000 non-hours of operation time yearly. (C.H.)

39531 (NP-14255) ANALYSIS OF RADIONUCLIDES IN WATER. (Public Health Service, Washington, D. C. and Robert A Taft Sanitary Engineering Center, Cincinnati). Sept. 1964. 193p.

A training manual is presented for use in a course on the measurement of radioactivity in the aquatic environment. Instruction is given on the determination of both gross radioactivity and specific radionuclides in aquatic samples. Both radiochemical and instrumental analyses are covered. (D.L.C.)

39532 (NP-14258) MEASUREMENT OF AIRBORNE RADIOACTIVITY. (Public Health Service, Washington, D. C. and Robert A. Taft Sanitary Engineering Center, Cincinnati). May 1964. 102p.

A training manual is presented for use in a course for professional personnel concerned with contamination of the air environment. After a consideration of the fundamentals, air sampling and air flow measurement are discussed. Analysis for gross radioactivity and for specific radionuclides is considered. Surveillance programs are discussed. (D.L.C.)

39533 (SC-TM-225A63(54)) BIOLOGICAL HAZARD EVALUATION FROM ORBITAL RE-ENTRY INJECTION OF Pu^{238}. Hugh W. Church (Sandia Corp., Albuquerque, N. Mex.). July 1963. Contract AT(29-1)-789. 6p.

An estimate is made of the hazard associated with release of ^{238}Pu as a satellite reactor re-enters the earth's atmosphere from orbit. It is concluded that the amount of material breathed per kilogram released is considerably less than the maximum permissible body burden. (auth)

39534 RAPID CARBON-14 TEST FOR COLIFORM BACTERIA IN WATER. Robert M. Scott, Dorothea Seiz, and Howard J. Shaughnessy (Dept. of Public Health, Springfield, Ill.). Am. J. Public Health, 54: 827-33(May 1964).

A new method of testing water for bacteriological safety, which depends upon the detection of the coliform group of bacteria by a rapid membrane filter test, is described. The test depends on the fact that when the bacteria are introduced into a new medium, they start metabolizing at

once. Thus, if coliform bacteria are introduced into a medium containing formate, multiplication may not occur for several hours but carbon dioxide is given off almost immediately. If ^{14}C-labeled formate is used, the evolved carbon dioxide will also be radioactive and measurable with any sensitive β-activity detector. This technique showed promise as a quick test for water pollution in time of emergency, since it can be completed in about four hr. The results of the tests showed that drinking water with no bacterial growth produce little radioactivity, while raw or contaminated water gave activity proportional to the density of the coliform present. If activity caused by other bacteria is detected, it must come from organisms in the water itself; although this is undesirable, it is probably not dangerous. Any error in interpretaion of results should be made on the safe side. Efforts to set up standards using pure cultures as a criteria of coliform activity required longer incubation periods than in the test itself, thus unduly delaying the results obtainable with this technique. (BBB)

39535 STRONTIUM AND CALCIUM IN FOODSTUFFS. V. Popovic and Radmila Radeka (Inst. for Medical Research and Occupational Medicine, Zagreb). Arhiv Hig. Rada i Toksikol., 14: 307-12(1964).

An examination of ^{90}Sr and Ca in some foodstuffs and fodder of vegetable origin was carried out in 1962 and 1963. Hay and alfalfa were mostly contaminated on the surface more so in the spring than in the summer due to the higher radioactive fallout in the spring. The activity of alfalfa was somewhat lower than that of hay because the roots of alfalfa are deeper and therefore less exposed to indirect contamination. Plants with a lower calcium content took less ^{90}Sr from the soil. (OTS)

39536 INVESTIGATIONS ABOUT THE BEHAVIOR OF LONG LIVING FISSION PRODUCTS IN DRINKING WATER. K. Aurand and H. Behrens (Institut fur Wasser-, Boden-, und Lufthygiene, Berlin). Atompraxis, 10: 346-51(Aug. 1964). (In German)

Determination was made of the ^{90}Sr contents of the river Weser and drinking water originating from the river water over the period of 1959 to 1963. A comparison with ^{90}Sr precipitation showed that the major part of ^{90}Sr from fallout is retained in the catchment area of the river by adsorption and is then again released very slowly. By this fact ^{90}Sr concentrations in river water (0.2–2 pC/l) are much lower than in rain (0.2–60 pC/l and fluctuations of ^{90}Sr concentrations appear to be largely equalized in river water. Owing to the continuous desorption of the ^{90}Sr deposited in the catchment area, there is only a slight decrease of the ^{90}Sr concentration in the river water in response to a significant reduction of ^{90}Sr fallout. The decontaminating effect of the usual methods of treatment of surface water for drinking purposes with regard to ^{90}Sr is too small to be of any importance from the viewpoint of radiation protection. ^{90}Sr was also detected in drinking water originating from artificially recharged groundwater as well as karst groundwater. (auth)

39537 STRONTIUM-90 AND CESIUM-137 IN CANADIAN CEREAL GRAINS 1957-1960. W. E. Grummitt (Atomic Energy of Canada Ltd., Chalk River, Ont.). Can. J. Bot., 42: 367-74(Mar. 1964).

Measurements of ^{90}Sr and ^{137}Cs were made on Canadian wheat grown from 1950 to 1960, in exports of wheat and barley during 1959, and in commercially produced flour and bran. For wheat grown in 1959 significant differences were observed in the concentration of both nuclides in the nine geographical areas studied. In wheat for the years 1957 to 1960 the concentration of the two nuclides appeared to be correlated, indicating that similar uptake mechanisms were involved. The decreased concentration seen in 1960 was a result of the cessation of weapons testing, leading to a reduced rate of fallout. Studies of the mechanism of ^{137}Cs uptake were also conducted. Cesium-137 in wheat from an experimental farm showed a strong dependence on fallout rate, but the countrywide mean only followed the trend in a general way. It was concluded that more than 95% of the uptake by the grain must have been by direct fallout onto the plant. Analytical results for Grades 2, 3, and 4 northern wheat shipped between November 1958 and November 1959 from Atlantic and Pacific ports showed that ^{90}Sr levels were highest in the lowest grade wheat, but ^{137}Cs was unrelated to grade. Little difference was observed between the levels of radioactivity in wheat and feed barley. For milled products the ratios in wheat to flour showed that most of the ^{90}Sr followed the bran. Cesium-137 also tended to follow the bran, being about twice as high in whole wheat as in flour, on a wt basis; however, the difference was not as marked as for ^{90}Sr. The distribution of $^{137}Cs/g$ K was relatively uniform in wheat. (BBB)

39538 DIRECTIVES OF EURATOM FIXING BASE NORMS RELATIVE TO SANITARY PROTECTION. Concours Med., 85: 3263-6(May 18, 1963). (In French)

Chapters of the Euratom directives pertaining to sanitary protection are reproduced with some comment. (TCO)

39539 EFFECT OF TYPE OF ACID AND TIME BETWEEN ACIDIFICATION AND RESIN CONTACT ON THE REMOVAL OF RADIOSTRONTIUM FROM MILK. D. G. Easterly, L. F. Edmondson, J. K. Avants, and A. M. Sadler (Dept. of Agriculture, Washington, D. C.). J. Dairy Sci., 47: 549-52(May 1964).

Studies were conducted to determine the effect of: the type of acid used for milk acidification, and the time interval between acidification and resin contact on the removal of radiostrontium from milk. The pH of milk labeled in vivo with ^{85}Sr was lowered to 5.3 with a 0.75N solution of either acetic, citric, hydrochloric, or phosphoric acid. Samples of 2.5 liters were passed through separate ion-exchange columns containing a cation resin. The use of citric acid effected 97.5% removal from 25 resin bed volumes of milk compared to 89.4, 88.4, and 83.1% for acetic, hydrochloric, and phosphoric acids, respectively. The lower removal obtained with phosphoric acid may be explained by the low solubility of the Sr phosphates and by the tendency of the alkaline earths to combine as phosphocaseinates, making these ions less available for cation exchange. The net charge of the complex is negative, even at a pH as low as 5.3. About 15% of the Sr is colloidally bound at a pH of 5.2 when citric acid was used for acidification, and it is probable that a greater amount is complexed when phosphoric acid is used for acidifying. Since little or no Ca and Sr complexes acetic and hydrochloric acids, these ions would, therefore, be more available for exchange. The greater removal obtained with citric acid than with acetic and HCl acids is probably related to its chelating effectiveness for divalent ions. Citrate may form complexes with alkaline earths having a net positive charge at the pH values employed. The results of the holding-time studies following continuous acidification showed a small but definite increase in the amount of Sr removed resulted when the holding time after acidification was increased from 0.5 to 60 min. (BBB)

39540 RADIOLOGICAL PROTECTION IN THE GERMAN DEMOCRATIC REPUBLIC. G. Sitzlack (Staatliche Zentrale für Strahlenschutz, Berlin-Friedrichshagen). Kernenergie, 7: 573-6(June-July 1964).

The function State Center for Radiation Protection is described as to correlate, register, evaluate, and implement functions pertaining to protection of personnel from radiation in general, and the population at large, in particular. The terms of reference of the State Center, its organizational layout, its principal functions, and its facilities are described. No references. (OTS)

39541 MEDICAL CARE OF RADIATION WORKERS. K. P. Duncan (United Kingdom Atomic Energy Authority, Harwell, Berks, Eng.). Lab. Pract., 254-9(Mar. 1963).

After a brief outline of the position of the medical supervisor in the radiation industry, the types of medical examination are described and the objects and contents of such examinations are described in detail. Various means of biological monitoring are briefly assessed and the value of blood examinations discussed. Methods of treatment and decontamination are given, and the last section is devoted to the long term aspects of medical care of radiation workers. (auth)

39542 ESTIMATING THE HAZARD DUE TO RADIOLYTIC PRODUCTS FROM THE AIR. L. N. Less (Imperial Coll. of Science and Tech., London) and A. J. Swallow. Nucleonics, 22: No. 9, 58-61(Sept. 1964).

The production of ozone and nitric acid around ^{60}Co gamma sources and of ozone around an electron linear accelerator was studied. The amount of ventilation required to control the ozone level in a room containing a large ^{60}Co gamma source or an electron accelerator was estimated. (D.C.W.)

39543 THE RADIATION PROTECTION REGULATIONS AND THEIR EXECUTION. Heinz Kuehn (Max Planck-Institut für Biophysik, Frankfurt am Main). Radiologe, 2: 384-9(Oct. 1962). (In German)

Maximal permissible limits for radiation exposure established by the ICRP are discussed. Procedures for collection, measurement, and disposal of radioactive wastes are described. Standards for ventilation of radioactive areas are presented, and simplified methods for disposal of solid or liquid wastes are detailed in the regulations. Measures adopted for carrying out the regulations are pointed out. (TCO)

39544 THE MEAN LEVEL OF ^{90}Sr IN THE DIET OF THE INHABITANTS OF BOLOGNA. M. Zanetti (Università, Bologna). Riv. Ital. Igiene, 22: 226-37(July-Aug. 1962). (In Italian)

The radioisotopes of biological interest introduced into the alimentary chain are tabulated; of these, that of major biological interest is considered to be ^{90}Sr. A discussion of the importance of different foods in as a source of ^{90}Sr includes estimation of the involvement of the Ca level and vitamin D level in milk, the lipids of milk, casein, and lactose, and the discrimination for Sr of these components; but cereal and vegetable sources are of great importance, as studies of ^{90}Sr intake in the U.S.A. and Japan have shown. The sources of Ca in the Italian diet are estimated to be: cereals, 19%; vegetables, 14%; meat, eggs, and fish, 5%; milk and milk products, 62%. The sources of ^{90}Sr in the Italian diet are: cereals, 35.8%; vegetables, 17.6%; milk and milk products, 46.6%. These are expected to be averages with wide oscillations in different parts of the country and according to different occupations. The mean annual consumption of various foods per capita is presented. The Ca content of the mean diet of the inhabitants of Bologna in mg/day, the mean value of the $^{90}Sr/Ca$ ratio in pC/day, and estimation of the amount of ^{90}Sr ingested in pC/day are given. Suggestions to help lower the value of ingested ^{90}Sr include supplementation of Ca in the diet and removal of ^{90}Sr from foods. An increase in the consumption of milk and milk products to decrease ^{90}Sr absorption is favored in this presentation. (TCO)

39545 THE SHELTER-CENTERED SOCIETY. Arthur I. Waskow (Peace Research Inst., Washington, D. C.). Sci. Am., 206: 46-51(May 1962).

A conference on the potential implications of a national civil defense program, held by the Peace Research Institute in Washington, D. C. on January 13 and 14, 1962, is reported. On one conclusion the conferees agreed: the existence of a shelter-centered civil defense would be a wholly new departure in U. S. history. Because the prospect is without precedent they did not attempt to produce ironclad predictions of what would happen. They sought rather to define the problems that are likely to develop. Evidence is presented which suggests that existing stresses and strains in the community would be amplified by emphasizing the threat of war. Of all the questions raised by civil defense, the conferees agreed, the most troublesome and dangerous is the question of how the commitment, once made, could ever be limited or reversed. Other topics discussed were attitudes toward disarmament, public opinion and official views toward civil defense in the U.S.S.R., and the problems that would arise were the civil defense program abolished now. (TCO)

39546 SYMPOSIUM ON THE TECHNICAL PROBLEMS OF RADIATION PROTECTION, WARSAW, 25-29 SEPTEMBER 1962. PART I. (Poland. Biuro Pelnomocnika Rzadu do Spraw Wykorzystania Energii Jadrowej. Centralne Laboratorium Ochrony Radiologicznej, Warsaw). 257p. (In Polish, German, and Russian)

The 21 papers compiled in Part I of the Symposium dealt with the organization of monitoring services, personnel radiation monitoring, and environmental contamination. Separate abstracts were prepared for 19 papers. (J.S.R.)

For abstracts of individual papers see: 39012, 39013, 39014, 39506, 39507, 39508, 39509, 39510, 39548, 39549, 39550, 39551, 39552, 39553, 39678, 39679, 39680, 39681, and 39682.

39547 SYMPOSIUM ON THE TECHNICAL PROBLEMS OF RADIATION PROTECTION, WARSAW, 25-29 SEPTEMBER 1962. PART III. (Poland. Biuro Pelnomocnika Rzadu do Spraw Wykorzystania Energii Jadrowej. Centralne Laboratorium Ochrony Radiologicznej, Warsaw). 255p. (In Polish, German, and Russian)

The 18 papers compiled in Part III of the Symposium dealt with the processing and elimination of radioactive wastes, radiation protection at reactors and accelerators, measurement methods and apparatus, and shielding. Separate abstracts were prepared for each paper. (J.S.R.)

For abstracts of individual papers see: 39554, 39555, 39556, 39683, 39684, 39685, 39686, 39687, 40491, 40762, 40763, 40764, 40964, 40965, 40966, 40967, 40968, and 40969.

39548 THE NEW ARRANGEMENT FOR RADIATION PROTECTION IN THE GERMAN DEMOCRATIC REPUBLIC.

G. Sitzlack. Symp. Tech. Zagadnien Ochrony Promieniowaniem, Warsaw, 18-24(1962). (In German)

The principal scientific and operative problems that arise in the radiation protection agencies of the German Democratic Republic are described. The new structure of the National Central Organization for Radiation Protection in the Ministry is presented. (tr-auth)

39549 PRACTICES OF THE RADIATION PROTECTION SERVICE OF THE CENTRAL INSTITUTE FOR PHYSICS. I. Fehér (Zentralforschungsinstitut fur Physik, Budapest). Symp. Tech. Zagadnien Ochrony Promieniowaniem, Warsaw, 25-46(1962). (In German)

The Central Research Institute for Physics is the center of nuclear physical and nuclear chemical researches in Hungary. At the research reactor and the accelerator installation of the Institute, numerous studies in nuclear physics, solid state physics, and nuclear chemistry are carried out. An intensive research program is also carried out at the zero-power reactor and in the area of the chemistry of nuclear-pure uranium. These works require a strong central radiation protection control. A review is given of the units of the organization and the practical performance of the radiation protection in the Institute. Examples are given of the studies made. (tr-auth)

39550 MAXIMUM PERMISSIBLE RADIATION LEVELS IN THE RNR (RUMANIAN PEOPLE'S REPUBLIC). E. Gashpar and M. Onchesku (Inst. Atomic Physics, Bucharest). Symp. Tech. Zagadnien Ochrony Promieniowaniem, Warsaw, 47-58(1962). (In Russian)

In accordance with the legal code of the Rumanian People's Republic, three zones with different permissible radiation limits were established. In each zone there is a variation between radiation burdens allowed for professional and nonprofessional personnel. (tr-auth)

39551 THE CONDUCT OF RADIATION PROTECTION INSPECTIONS IN THE DDR (GERMAN DEMOCRATIC REPUBLIC). R. Ott. Symp. Tech. Zagadnien Ochrony Promieniowaniem, Warsaw, 59-62(1962). (In German)

The problems of the radiation protection inspections for the small consumers of radioactive materials and especially suggestions for the improvement of the radiation protection conditions are reported. The organization and the tasks for radiation protection inspection in the German Democratic Republic were explained. (tr-auth)

39552 CENTRAL PERSONNEL RADIATION PROTECTION MONITORING IN THE DDR. W. Kiesewetter (Amt. fur Kernforschung und Kerntechnik Arbeitsatelle, Dresden). Symp. Tech. Zagadnien Ochrony Promieniowaniem, Warsaw, 116-30(1962). (In German)

After introductory considerations on the special tasks of personnel radiation monitoring and the requirements of local (site and work dosimetry) and remote-control monitoring of the individual radiation burdens over a long period of time, the practices for centralized radiation monitoring in the German Democratic Republic are reported. In a brief consideration of the radiation indicators apparently suitable for long-distance monitoring, it is shown that the requirements of routine measurements are best fulfilled with photographic emulsions. The practical execution of personnel radiation monitoring is described, and the characteristics of different film packets and their development are discussed. The technical and organizational monitoring functions are sketched with special consideration of the requirements recommended by the International Radiation Protection Commission. In order to comply with the legal requirements for the health control of persons working with radiation, a norm was established for the radiation monitoring carried out with film packets. (tr-auth)

39553 MEASUREMENT OF RADIOACTIVE CONTAMINATION OF SURFACES. T. Musialowicz, S. Dyz, and J. Jakubiak (Central Laboratory for Radiological Protection, Warsaw). Symp. Tech. Zagadnien Ochrony Promieniowaniem, Warsaw, 247-51(1962). (In Polish)

Methods used for the determination of α and β contamination of work surfaces and for personnel monitoring are described. The highest permissible contamination of the surface, according to the type of emitter and the contamination site, is reported. The Soviet TISS and the English Ericsson instruments with α and β probes were used for the measurements. The contamination measurements for low-energy β emitters were made with the TISS with a suitable probe (7 G-M bubble counters of the AAH-55 type). The instruments were calibrated with standard surfaces contaminated with ^{239}Pu, natural uranium, ^{90}Sr, and ^{14}C. (tr-auth)

39554 COMPLEX FILTER FOR PURIFICATION OF NATURAL WATER. J. Horski, A. Siemaszko, L. Lowczynski, J. Bulanda, Z. Smal, and Z. Makles (Inst. of Nuclear Research, Warsaw). Symp. Tech. Zagadnien Ochrony Promieniowaniem, Warsaw, 580-608(1962). (In Polish)

The use of cellulose sorbents for the purification of natural waters (pond, river, and sea) from radioactive contamination and chemical and bacteriological impurities is described. An isotopic mixture of ^{90}Sr and ^{137}Cs and other long-lived isotopes was used for the radiation contamination. Chloropicrin was used as the chemical contaminant because of its permanent character and good solubility. The bacteria Coli communae was the bacteriological impurity. The absorptive materials had the same granulation as that found in contact filters. Filters of cellulose with a hi high capacity for filtering colloidal suspensions were analyzed. On the basis of the studies made, specifications for the construction of a portable filter with a capacity of 100 to 300 l/hr are presented. (tr-auth)

39555 ESTABLISHMENT OF THE HEIGHT OF CHIMNEYS FOR OFF-GASES FROM NUCLEAR ENERGY INSTALLATIONS. U. E. Michaelis (VEB Energieprojektierung Kerntechnische Anlagen, Berlin). Symp. Tech. Zagadnien Ochrony Promieniowaniem, Warsaw, 662-8 (1962). (In German)

The permissible discharge of radioactive gases and aerosols from the chimney was determined as a function of the effective chimney height on the basis of meteorological evaluations and the MPC in the chimney vicinity. Resulting gas masses, gas characteristics, and especially the radioactivities are the decisive factors for the economically most suitable disposal of off-gases on which the selection of the chimney height is directly dependent. After selection of the system for off-gas treatment, such as gas decay containers, and aerosol filters, and off-gas velocity measurements, the minimum chimney height necessary was determined from the data on the necessary effective chimney height. (tr-auth)

39556 APPARATUS FOR INDUCTION OF GREAT QUANTITIES OF AIR FOR MEASUREMENT IN URBAN CONDITIONS OF ATMOSPHERIC RADIOACTIVE CONTAMINATION PRODUCTS FROM NUCLEAR FISSION EXPLOSIONS. Z. Zakrocki (Inst. of Nuclear Research, Krakow). Symp. Tech. Zagadnien Ochrony Promieniowaniem, Warsaw, 730-45(1962). (In Polish)

A device was constructed that is suitable for the measurement of the radioactivity in air at high dust levels. It was established that in periods of high dust levels, the air throughput decreases about 70% because the filter is stopped up, from initial values of 60 m^3/hr and pressures of 2 cm Hg. The apparatus constructed will transport approximately 1200 m^3 air/24 hr at throughputs of 60 m^3/hr and 2 to 3 cm Hg. The air was led over round Whatman 41 fiber filters with a diameter of 145 mm. New filters were automatically introduced when needed, insuring a constant air flow. The air had a direct path to the filter surface. The device is automatic and is of simple construction. (tr-auth)

39557 INSTRUCTIONS FOR HANDLING ENCLOSED RADIOACTIVE SUBSTANCES. H. Muth, A. Kuhlmann, K. Aurand, A. Cantzler, W. Gliwitzky, and W. Jacobi (Deutsche Gesellschaft fur Arbeitsschutz e. V., Frankfurt am Main). Zentr. Arbeitsmed. Arbeitsschutz, 12: 36-9(Feb. 1962). (In German)

The most important legal controls for handling enclosed radioactive materials are collected and combined with practical advice. The general requisites for handling and transport of enclosed radioactive substances are discussed, including the requirements for granting a license for handling or for transport. Maximum permissible concentrations for exposed personnel are discussed, with a section on medical supervision. The legal requirements for instruction and display of radiation protection regulations are outlined. Management transport, storage, labeling, and bookkeeping requirements and suggestions are outlined. The area of control and supervision is outlined; radiation protection control, including personnel and samples, is discussed. Handling and sealing of enclosed emitters and measurements in case of accidents are discussed. A table of decay factors for ^{60}Co, ^{170}Tm, ^{147}Pm, ^{192}Ir, ^{204}Tl, ^{85}Kr, ^{90}Sr, and ^{137}Cs is given as percent activity remaining after 0.25 to 10 yr. The laws pertain to the Federal Republic of Germany. (BBB)

39558 BACKGROUND MATERIAL FOR THE DEVELOPMENT OF RADIATION PROTECTION STANDARDS. Report No. 5. (Federal Radiation Council, Washington, D. C.). July 1964. 18p. $0.20(GPO).

Following release of fresh fission products, iodine-131 is the radionuclide considered most likely to reach concentrations in foods which warrant protective action to reduce the projected dose. The important mode of transmission to humans is through the consumption of fresh fluid milk. Iodine-131 can appear in milk within a few hours after its deposition on pasture. The concentration in milk may reach a maximum in two to four days, after which the concentration diminishes by half about every five days. Removal of dairy cattle from contaminated pastures or the diversion of contaminated milk to processed dairy products are recommended as protective actions to reduce human exposure from iodine-131. The Federal Radiation Council has developed the concept of the Protective Action Guide. The PAG is defined as the projected absorbed dose to individuals in the general population which warrants protective action following a contaminating event. A projected dose of 30 rads to the thyroid of individuals in the general population has been recommended as the Protective Action Guide for iodine-131. As an operational technique it is assumed that this condition will be met effectively if the average projected dose to a suitable sample of the population does not exceed 10 rads. (auth)

39559 DEZAKTIVATSIYA SREDSTV INDIVIDUAL'NOI ZASHCHITY I ZASHCHITNYKH POKRYTII. (Decontamination Methods for Protection of Personnel and for Protective Surfaces). S. M. Gorodinskii, Z. E. Panfilova, D. C. Gol'dshtein, and L. M. Nosova. Moscow, Atomizdat, 1964. 120p.

Various methods and means for personnel protection are discussed, and coating compositions for protecting surfaces and their decontamination are evaluated. 62 references. (R.V.J.)

39560 ESTIMATES OF THE SOLAR PROTON RADIATION HAZARD FOR MANNED SPACECRAFT BASED ON A MODEL ENVIRONMENT CONSTRUCTED FOR THE LAST SOLAR ACTIVE YEARS (1956-1961). Charles H. Warneke (McDonnell Aircraft Corp., St. Louis). 22p. (CONF-446-26)

From American Nuclear Society 10th Annual Meeting, Philadelphia, June 1964.

Surface and 5 cm-depth doses were estimated for a spherical water phantom at the center of a spherical aluminum shield, ten feet in diameter, for each of the 30 significant solar proton events that took place during the years 1956–1961. These doses were used in constructing an environment of 144 one-half month successive time intervals. It is assumed that space missions ensue at the beginning and middle of each month during the above time period and encounter the appropriate portion of the dose environment that their mission times encompass. If it is assumed that future solar proton environments will be very similar to that constructed for the years 1956–1961, estimates can be made of the shielding requirements for future space missions. In making dose estimates based on the environment constructed the large degree of uncertainty that the doses presented no doubt contain must be taken into account. The uncertainty in these doses is probably as large as a factor of 2 or 3. However, even with these large uncertainties taken into account, light shielding (one or two grams per square centimeter) appears to be sufficient to keep the total surface dose below 300 rads for short missions of up to two weeks duration providing a risk factor of a few percent is accepted. (P.C.H.)

39561 FUTURE TRENDS IN THE ASSESSMENT OF HAZARDS FROM FISSION PRODUCT RELEASES. J. R. Beattie (United Kingdom Atomic Energy Authority, Risley, Eng.). 9p. (CONF-337-58)

From International Conference on Radioactive Pollution of Gaseous Media, Saclay, France, Nov. 1963.

The release of fission products and its radiobiological effects in the event of an accident are considered. Previous assessments, reactor fuels and fission product releases, removal of iodine by deposition, filtration/absorption plant, and other processes, and hazards from a release of fission product noble gases are discussed. Methods for the removal of iodine and other volatile or particulate fission products together with improvements in the intrinsic safety of reactors should eventually justify the progressive relaxations in site selection criteria that may be required for future power reactors. (P.C.H.)

39562 ATMOSPHERIC KRYPTON-85 DURING 1962 AND 1963. D. Ehhalt, K. O. Muennich, W. Roether, J. Schoelch, and W. Stich (Universität, Heidelberg). 9p. (CONF-337-37)

From International Conference on Radioactive Pollution of Gaseous Media, Saclay, France, Nov. 1963.

An investigation was made to determine whether ^{85}Kr found in the atmosphere is due to bombs to any appreciable extent or not, simply by recording the variations of ^{85}Kr activity with time. No significant seasonal variation was found during 1962. The extension of the measurements for another essentially gave the same picture, again pointing to a primarily industrial origin of the ^{85}Kr. (P.C.H.)

39563 DRY PURIFICATION OF INCINERATOR OFF-GASES. P. Dejonghe, J. Pyck, and N. Van de Voorde. 17p. (CONF-337-57)

From International Conference on Radioactive Pollution of Gaseous Media, Saclay, France, Nov. 1963.

During operation of an incinerator for radioactive wastes, black smoke is formed, primarily while burning plastics or rubber. The black smoke, which is not cleared in a cyclone, coagulates on the prefilters and causes almost instantaneous plugging. In order to solve this problem an attempt was made to preclean the gases by filtration through different types of tissues or by electrofiltration. For gases, containing 5 g of humidity per m^3, one succeeded in retaining 93% of the carbon black in a double stage electrofilter. The life time of the tissue-filters was thus prolonged by a factor of approximately 10. The flow-rate through the electrofilter was between 0.4 and 1.0 m/sec. (auth)

INSTRUMENTATION

General

39564 (AERE-M-1410) CALCULATIONS OF ELECTRON TRANSIT TIMES IN TWO ELECTRON-OPTICAL STRUCTURES. P. Iredale (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Aug. 1964. 11p.

Simple calculations were made of the transit times of electrons in an image converter with electrodes in the form of concentric spheres and for a continuous channel type of electron multiplier. (auth)

39565 (COO-712-73) NEUTRON-MODERATION MOISTURE METERS: ANALYSIS OF APPLICATION TO COAL AND SOIL. Final Report. R. A. Semmler (Chicago. Univ. Lab. for Applied Science). Sept. 1963. Contract AT(11-1)-712. (LAS-TR-161-67) 144p.

The influence of elements other than hydrogen on neutron-moderation moisture gages using a Ra–Be neutron source is examined. A point source in a spherical cavity is used as a model of the gage. Formulas are given to compute the change in gage response caused by a change in composition using both two-group theory and age-diffusion theory. Moisture gage response in coal is found to be significantly affected by the carbon density because of significant changes in the fast neutron transport cross section. The constants required for the calculations are tabulated for Al, B, C, Ca, Cl, Fe, H, K, N, Na, O, Si, and H_2O so that gage response or parameters such as the Fermi age can be calculated for other media and other applications. The terminology and theory of neutron moderation is briefly reviewed. Thermal neutron flux equations are given for several geometries including a point source in a spherical cavity which is gray to both fast and slow neutrons. (auth)

39566 (IFA-IS-31) KONSTRUKTION UND ARBEITSWEISE DES ELEKTROLYTLEITFAHIGKEITSDETEKTORS. (Construction and Operation of Electrolyte Conductivity Detectors). O. Piringer, E. Tătaru, and M. Pascalău (Academia R. P. R. Institutul de Fizica Atomica, Cluj). 1964. 10p.

Details are provided on the construction and operation of the electrolyte conductivity detector based on the combustion of the components into carbon dioxide and the determination of latter by means of differential electrolytic conductivity measurement. The sensitivity, linearity, indication rate, advantages, and disadvantages of the detector were compared to those of the detectors most commonly employed. (auth)

39567 (IDO-16977(p.44-54)) INSTRUMENT DEVELOPMENT. (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho).

The August 1963 TRIGA Proof Test indicated the effects of neutron and gamma dose rates on the induced electrical transients in various types of pressure transducers. The results demonstrate the importance of using proper circuitry and the difficulty of extrapolating the results to other radiation fields. Some of the types tested are suitable for "near-core" measurements in the Spert and STEP destructive tests. An analog computer study of the In-Pile Fatigue Test temperature control of the test sample resulted in a controller system design capable of maintaining the sample temperature within ±5°C. Control is achieved by two heaters in the temperature controlling gas stream. The heaters in turn are controlled by two 3-mode controllers in a two-loop feedback system. A fuel plate spacing gage is developed that operates on the eddy current loading of a sensing coil by the fuel plate. It measures spacings of 68 to 90 mils over a 50-inch length. (auth)

39568 (LA-DC-6242) THE EFFECT OF AN AXIAL TEMPERATURE GRADIENT ON THE APPARENT PRESSURE IN A KNUDSEN EFFUSION CELL. Edmund K. Storms (Los Alamos Scientific Lab., N. Mex.). [1963]. Contract W-7405-eng-36. 15p. (CONF-649-1)

From 12th Annual Conference on Mass Spectrometry and Applied Topics, Montreal, June 1964.

A study was made on the error introduced by a temperature gradient into Knudsen effusion cell measurements and on the mechanism of that error. A graphite crucible with a conical shaped interior was used with three filaments for producing extreme temperature gradients. Gold was used as the test material, and results are given for the respective cases where the top and bottom was the hotter. The implications of the results and the effects of crucible design and material on the error are discussed. (D.L.C.)

39569 (NAA-SR-Memo-9685) THERMOCOUPLE EVALUATION PROGRAM. Status Report. W. K. McCarty (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Mar. 25, 1964. Contract [AT (11-1)-Gen-8]. 9p.

Efforts under several programs to improve thermocouples for use in a nuclear environment and specifically frequent thermal shocks due to reactor scrams were coordinated to increase the effectiveness of the effort. The present status of the work is described. Results of the program lead to the conclusion that sheathed thermocouples which will be subject to thermal shock should be composed of sheath and wires having compatible coefficients of thermal expansion, have an insulation compaction density of 90 to 95%, and have floating hot junctions. (auth)

39570 (NP-8520) DATA PROCESSING. R. Winckler (European Company for the Chemical Processing of Irradiated Fuels, Mol, Belgium). Sept. 21, 1959. 20p. (ETR-66)

The proposed Eurochemic data processing equipment is compared with more conventional equipment and instrumentation. Eurochemic data processing schemes are described. (J.R.D.)

39571 (NP-14295) VARIOUS FILTERS FOR THE DETECTION OF NUCLEAR EXPLOSIONS OF MICROBAROGRAPHIC RECORDS. E. A. Robinson (Sweden. Försvarets Forskningsanstalt, Stockholm). Oct. 1962. 8p.

A study is made of the analysis of microbarographic recordings in order to detect signals caused by nuclear explosions. Signals of high energy content are easily detected visually, but as the signal energy decreases, visual detection becomes progressively more difficult until the point is reached where the signal is completely masked. As a preliminary step in the analysis of the microbaro-

graphic time-series, the trend component resulting from atmospheric conditions should be removed. The following kinds of filters which may be used for signal detection are considered: matched filter, modified matched filter, matched filter for multiple alternative signals, spike filter, traveling signal-to-noise ratio estimates, and noise suppression by prediction. (auth)

39572 (TID-20893) STANDARD NUCLEAR INSTRUMENT MODULES. Louis Costrell (National Bureau of Standards, Washington, D. C.). July 1964. 14p.

General specifications for standard instrument modules, which can be interchanged physically and electrically, are discussed. These form the recommendations of the AEC Committee on Nuclear Instrument Modules. (R.E.U.)

39573 (TID-20944) TUNGSTEN/TUNGSTEN-RHENIUM THERMOCOUPLE RESEARCH AND DEVELOPMENT. J. A. McGurty and W. C. Kuhlman (General Electric Co. Flight Propulsion Lab. Dept., Cincinnati). [1962]. Contract AT(40-1)-2847. 20p. (TM-62-4-2)

The status of refractory metal thermocouples for high-temperature applications is discussed with emphasis on the W/W-26 Re couple. Thermoelements, insulators, and sheathing are considered. (D.L.C.)

39574 (Y-1466) LENGTH-MEASURING LASER INTERFEROMETER. H. S. Corey, C. M. Lay, R. W. Schede, and R. E. Sladky (Union Carbide Corp. Nuclear Div. Y-12 Plant, Oak Ridge, Tenn.). June 19, 1964. Contract W-7405-eng-26. 19p.

A length-measuring interferometer utilizing a continuous laser light source has been successfully used in connection with an inspection machine. Measurements made on a ten-inch gage block demonstrated a combined accuracy and precision of better than 10 microinches at this distance. Information is also available concerning the method of calculating the precise wavelength of the 6328 Å laser emission. The validity was established by the gage block measurements. (auth)

39575 TESTING VARIATION COUNTER EFFICACY ON VARIOUS SPECIMENS WITHOUT CHANGING CALIBRATION. V. Popovic and Katarina Ban (Inst. for Medical Research and Occupational Medicine, Zagreb). Arhiv Hig. Rada i Toksikol., 14: 313-16(1964).

Samples of various activities and various degrees of energy were tested with a 5% counting error by counters of various construction whose efficacy was determined by means of the ^{40}K standard. The activities of the samples, corrected to the back ground and efficacy, were tested by the method of variance. The O-hypothesis is accepted, which means that the differences in the activities registered by all the counters were not statistically significant. (OTS)

39576 A COMBINED DEVICE FOR MEASURING DENSITY AND WATER CONTENT IN LIVING TREE TRUNKS. H. Hinsch and E.-G. Niemann (Technische Hoshschule, Hanover). Atompraxis, 10: 372-6(Aug. 1964). (In German)

The construction of a device that makes it possible to measure density and moisture in the living tree is described. The two parameters were evaluated by a probe that is inserted into a drill-hole in a trunk. The density is measured by the back-scattered gamma radiation of radium D, the water content by a measurement of the dielectric constant of the fresh wood. Advantages and disadvantages of the different measuring methods are discussed, and calibration curves for density and moisture are given. (auth)

39577 EFFECT OF MAGNETIC SHIELDING ON HOMOGENEITY OF A MAGNETIC FIELD PRODUCED BY A PAIR OF COILS IN HELMHOLTZ POSITION. APPLICATION TO A NUCLEAR MAGNETIC RESONANCE SPECTROGRAPH WITH WEAK FIELD. Michel Sauzade and Francois Salle (Faculte des Sciences, Orsay, France). Compt. Rend., 259: 73-6(July 6, 1964). (In French)

The effect of a magnetic screen on the field of two coils in the Helmholtz position was calculated. The first experimental results obtained on the hypophosphite ion, using the magnetic shielding to improve the sensitivity of a classical low-field spectrograph, were reported. The magnetic shielding increased the polarization and protected the directive field against external fluctuations. (J.S.R.)

39578 EXPERIMENT FOR ABSOLUTE MEASUREMENT OF NUCLEAR POLARIZATION IN A LARGE TARGET. Maurice Chapellier. Compt. Rend. 259: 112-15(July 6, 1964). (In French)

The nuclear polarization of a cylinder of $La_2Mg_3(NO_3)_{12} \cdot 24\ H_2O$ containing 1% Nd and polarized by the solid effect method was determined by a method involving comparison of the magnetization of the dynamically polarized protons with that of a paramagnetic liquid of known susceptibility. (D.C.W.)

39579 EFFECTS OF RADIATION ON ELECTRONIC COMPONENTS. Edward Tromanhouser. Electron. World, 70: No. 1, 76-7(July 1964).

A review is given of radiation effects on resistors, capacitors, semiconductors, vacuum tubes, gas tubes, phototubes, and insulators. (C.E.S.)

39580 PRE-IMPULSES IN SHORT-TIME PHOTOMULTIPLIERS. M. Bonitz, W. Meiling, and F. Stary (Zentralinstitut fur Kernforschung, Rossendorf, Ger.). Exptl. Tech. Physik, 12: 127-9(1964). (In German)

Oscillographic measurements and observations of fluctuations in anode current impulses are reported. The main pulse is preceded by another small one of about 10-nsec duration. The distance between both pulses varies with the voltage on the focussing electrodes, but not with the voltage on any of the other electrodes in the photomultiplier. (auth)

39581 METHOD FOR STABILIZING THE OUTPUT OF NEUTRON GENERATORS WITH DEFLECTION MAGNETS. E. Pásztor and I. Veress (Zentralforschungsinstitut für Physik, Budapest). Exptl. Tech. Physik, 12: 190-2(1964). (In German)

A method for obtaining a constant yield from a neutron generator by ion bundle stabilization with deflection magnets. The arrangement of the system for direction stabilization with deflection magnets. The arrangement of the system for direction stabilization of the ion beam is shown. This arrangement gave a neutron yield that was constant to about ± 2%. (M.C.G.)

39582 AN EQUIPMENT FOR GAMMA RADIATION INVESTIGATION OF ORIENTED NUCLEI. Miroslav Kolář, Jiří Nedvěd, František Soukup, Stanislav Šafrata, Miloslav Šott, and Karel Švec (Inst. of Nuclear Research, Czechoslovak Academy of Sciences, Rez.). Jaderna Energie, 10: 243-6(1964). (In Czech)

Equipment in which a temperature of the order 0.01°K was reached is described. Measurements of the dependence of angular distribution of gamma radiation on the temperature were carried out for ^{60}Co nuclei, the spins of which were oriented at these temperatures utilizing internal field anisotropy in paramagnetic crystal. The results were found in accordance with theory and measurements carried out by other methods. (P.C.H.)

39583 PULSE TECHNIQUES IN THE NANOSECOND REGION. E. Baldinger (Universität, Basel). Neue Tech., 6: 191-8(July 1964). (In German)

The development of the nanosecond technique is reviewed, and suitable definitions for rise time and delay are introduced. Wide band amplifiers, oscilloscopes, and auxiliary equipment for the generation of test pulses are discussed. (auth)

39584 THE I.K.O. ISOTOPE SEPARATOR. K. J. Van Oostrum and J. H. Dijkstra (Instituut voor Kernphysisch Onderzoek, Amsterdam). Nucl. Instr. Methods, 29: 231-40(Oct. 1964).

The construction of an electromagnetic laboratory isotope separator is discussed. The instrument has a uniform magnetic sector field with a deflection angle of 90 degrees and a radius of curvature of 1.60 meters. The general features of the machine are surveyed, and technical details are given. Emphasis is laid on those parts, in which new developments were made. The ion beams are scanned with a thin wire driven through the collector box by an electromotor. The position of the ion beams on the collector screen is stabilized by means of a feedback system working on the acceleration voltage as well as on deflection plates in the lens box. The frequency dependence of both loop gains is considered and the defocusing effect on ion beams different from the stabilized beam is found to be negligible. The mass of the separated isotope is indicated by a mass meter giving an output voltage proportional to B^2/v. (auth)

39585 A SOURCE OF LITHIUM IONS OF HIGH INTENSITY. A. Septier and H. Leal (Faculte des Sciences, Orsay, France). Nucl. Instr. Methods, 29: 257-60(Oct. 1964). (In French)

In using the thermo-emission properties of a lithium salt (Beta-Eucryptite), a Li^+ ion-source was realized under the simple form of a triode gun, the efficiency of which approaches 100%. The emission surface is heated by electronic bombardment. The current is 15 mA for an accelerating voltage less than 10 kv. The low working temperature of the source (about 1300°C) thus prolongs the lifetime of the emitter to several tens of hours. The beam has a cross-section area of 4×1 cm^2 on leaving the source and a relatively small angle of divergence. (auth)

39586 A UNIVERSAL TIMER. H. Reker (Kernforschungszentrum, Karlsruhe, Ger.). Nucl. Instr. Methods, 29: 299-305(Oct. 1964). (In German)

A timer is described which gives time-intervals between one and 9999 seconds in steps of one second. The relative accuracy of these intervals is in the range 6×10^{-5} and the deviations from an official time-signal with a higher relative accuracy (in the range of 10^{-8}) will be measured. Besides the timer gives time signals with frequencies of 10,000, 1000, 100, 10 of 1 Hz for coupling other time interval-units. A special set gives the possibility of calibrating feather-clocks. (auth)

39587 A DIGITAL COMPARATOR FOR BINARY OR BINARY-CODED DECIMAL NUMBERS. C. H. Vincent (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). Nucl. Instr. Methods, 29: 306-8(Oct. 1964).

The problem of comparing two binary or binary-coded decimal numbers to determine which is the greater or to recognize equality when it occurs is examined. It is shown that this problem can be economically and conveniently solved by means of standard NOR and NAND circuits, with all the engineering advantages that that implies. The digital inputs to the comparator for both numbers can be taken directly from electronic sources such as binary scaler stages. The response is always simultaneous with the inputs, apart from the usual brief propagation delay, which is typically of microsecond order. There is no limitation on the number of stages that may be used. (auth)

39588 A LOW INDUCTANCE SHUNT FOR MEASURING HEAVY CURRENT PULSES. J. D. Milne, K. D. Srivastava, and M. N. Wilson (National Inst. for Research in Nuclear Science, Chilton, Berks, Eng.). Nucl. Instr. Methods, 29: 356(Oct. 1964).

Small coaxial shunts designed for measuring heavy current pulses in pulsed magnets are described. (C.E.S.)

39589 CHARACTERISTICS CHANGES OF FOUR-LAYER ARRANGEMENTS AND CONTROLLED RECTIFIERS AS A RESULT OF IRRADIATION WITH FAST NEUTRONS AND GAMMA QUANTA. K. Zander (Hahn-Meitner-Institut für Kernforschung, Berlin). Nukleonik, 6: 186-92(July 1964). (In German)

The dependence of the changes of forward-inverse current and forward current and of sweep and holding current, as well as the sweep and gating potential, on the absorbed dose of fast neutrons is discussed and compared with measurements obtained during irradiations in the BER Reactor. (L.B.S.)

39590 THE GENERATION OF MILLIMETER WAVES FROM CYCLOTRON EXCITATION OF TRAPPED ELECTRONS. H. Dressel and G. E. Weibel (General Telephone and Electronics Lab. Inc., Bayside, N. Y.). Proc. IEEE (Inst. Elec. Electron. Engrs.), 51: 1149(Aug. 1963).

Some results are reported of studies involving a vacuum tube device utilizing cyclotron excitation of trapped electrons to generate pulsed microwave energy at millimeter and submillimeter wavelengths, the Tornadotron. The basic mechanism of the Tornadotron involves the conversion of energy from microwave to millimeter wavelengths in a cycle of operations performed on a trapped pencil cloud of electrons. The cycle of operations consists of four consecutive phases. During the first phase, electrons are injected and trapped inside a chamber forming a pencil cloud of space charge. During the second phase of operation, orbital motion of the cloud is induced through the use of cyclotron resonance at microwave frequency. In the third phase, after orbital motion has been established, a pulsed high-magnetic field is applied that increases by a factor of up to 100 the frequency of orbital motion and the rotational kinetic energy of the electron cloud. As the magnetic field approaches peak value in the final phase, radiation of power at short wavelengths is obtained from the rapidly swirling electron cloud. An experimental tube designed to study all phases of operation has been built and tested. The feasibility of generating millimeter waves from the cyclotron excitation of trapped electrons by operation of a device based upon this principle to wavelengths approaching one mm. It is believed that the power capability of advanced devices of this type can be greatly increased over that presently realized by optimized and restricted frequency-selective coupling between the orbiting cloud and chamber fields, improved cloud compression, and optimization of the operating parameters. The possibility of restricting output to a narrow frequency range (quasi-monochromatic) by making use of controlled interaction with a high-Q higher-order mode chamber resonance illustrates one further step in development indicated by this investigation. (BBB)

39591 A SIMPLIFIED ANTICOINCIDENCE CIRCUIT. T. A. Brody and A. C. Nava Jaimes (Universidad Nacional de Mexico, Mexico City). Rev. Mex. Fis., 13: 75-85 (1964). (In Spanish)

A simplified anticoincidence circuit for GM counters is described, in which the counter tube itself acts as the anticoincidence element. The circuit is extremely simple, containing no active elements beyond two diodes. The resolution time is long, of the order of the counter dead time, but the stability of the circuit is sufficient to allow very long counting times, so that the circuit is suitable for low-level counting. A variant is also described, which may be used for mutual anticoincidence counting; this circuit requires one double triode or two transistors. (auth)

39592 A SINGLE-EVENT NANOSECOND SAMPLING OSCILLOSCOPE USING DYNAMIC SIGNAL STORAGE. Daniel Maeder (Université, Geneva). Z. Angew. Math. Phys., 15: 426-8(July 25, 1964).

A single-sweep, multiple-sample oscilloscope featuring storage in a transmission line is described, with which overall rise times on the order of 1.2 nsec can be obtained. (D.C.W.)

39593 PROPERTIES AND APPLICATIONS OF AN ULTRAFAST FLIP-FLOP CIRCUIT. Daniel Maeder (Université, Geneva). Z. Angew. Math. Phys., 15: 429-32(July 25, 1964).

A flip-flop circuit with a dead time on the order of 7 nsec is described, together with its operation as an oscillator, binary scale, and univibrator. (D.C.W.)

39594 TEMPERATURE CONTROL DEVICE (Engineering Materials). (Brookhaven National Lab., Upton, N. Y.). (CAPE-1117)

A drawing is presented for a device that provides a true proportional control of temperature. The device is extremely simple and requires a 6.3 v a-c power source. The oven used is contained in an aluminum box $1\frac{1}{2}$ in. × 2 in. × 3 in. with styrofoam used as an insulation. The nichrome heater is protected by a $\frac{1}{16}$ in. copper isothermal shield. There are control and monitor thermistors. Oven and circuit drawings are available. The circuit is active during those supply voltage alternations in which the upper bus is negative. Temperature error produces a small unbalance in the bridge consisting of 3 resistors and the control thermistor. The bridge delivers input to a 4 stage direct-coupled amplifier which employs cascaded transistors of alternated polarity. The collector current of each transistor is of the proper polarity to forward bias the base-emitter junction of the next. The output stage is a peak-reading emitter follower which supplies filtered d-c to the heater. A 5.1 v Zener diode clips the applied voltage to a constant level. This diode is used as a precise voltage reference. This control device was tested for a week; the temperature did not drift more than 0.01°C from the preset value of ~50°C. The room temperature varied over a range of 5°F. For a listing of this title, see the Engineering Materials List (TID-4100). (C.E.S.)

39595 SCANNING PROJECTOR VA (Engineering Materials). (California. Univ., Berkeley. Lawrence Radiation Lab.). (CAPE-1060)

Drawings (332) are presented for the SP-VA scanning table, a projection scanning machine suitable for viewing a variety of film sizes including 35, 46, and 70 mm films and in formats containing from one to three films each. The film is advanced by a d-c servo system driving a capstan. Operator control is through a "joystick." For a listing of individual titles, see the Engineering Materials List (TID-4100). (C.E.S.)

39596 THE EFFECTS OF NUCLEAR RADIATION ON A WESTON CADMIUM CELL. Walter B. Windus. 19p. (CONF-637-1)

From Institute of Electrical and Electronics Engineers Region 3 Annual Meeting and Technical Conference, Clearwater, Fla., May 1964.

Unsaturated Weston cadmium cells were irradiated in the nuclear reactor at Washington State University continuously for a period of 6 hr at a neutron flux of 5×10^{11} n/cm^2 sec and a gamma flux of 3×10^7 rad. The temperature of the cells rose 55°F above the ambient temperature of 78°F. The flux gradient caused unequal heating in the cell resulting in significant temperature differences between the two legs. When this temperature difference was eliminated it was observed that the voltage of the cell decreased about 0.21% due to radiation. The voltage recovered its original value in about three weeks. Two weeks after irradiation the internal resistance had increased to a value four times the original value. One week later it was steady at twice the original value. A theoretical explanation of this effect is presented. The Pyrex glass container had turned light brown and a fine black precipitate was observed in the solution of cadmium sulfate. (auth)

39597 A PLASMA RADAR SYSTEM. Sheldon B. Herskovitz (Air Force Cambridge Research Labs., Bedford, Mass.). 29p. (CONF-637-2)

From Institute of Electrical and Electronics Engineers Region 3 Annual Meeting and Technical Conference, Clearwater, Fla., May 1964.

A hypothetical all-plasma-state radar system and the possibilities of fabricating such a system in the future are described. Possible components of this system include some plasma electronic devices already available, some currently being developed, and some upon which there is only theoretical groundwork. The antenna is considered the part of the system still requiring most development. Advantages of the system might include greater bandwidths and tolerance of higher ambient radioactivity levels than conventional systems. On the other hand, noise in plasma devices may offer technological problems. (A.G.W.)

39598 RADIATION HARDNESS CONSIDERATIONS: ELECTRONIC COMPONENT PARTS, MATERIALS, AND CIRCUITS. John A. Bauer (Martin Co., Orlando, Fla.). 17p. (CONF-637-3)

From Institute of Electrical and Electronics Engineers Region 3 Annual Meeting and Technical Conference, Clearwater, Fla., May 1964.

Permanent damage to electronic component parts and materials resulting from the radiation pulse associated with a nuclear detonation is evaluated. Transistors, diodes, capacitors, resistors, insulators, transformers, and amplifying devices are considered. It is concluded that it is entirely feasible to find types of all high population electronic component parts capable of withstanding 10^{16} n/cm^2 or better with the exception of transistors. The transient effects of the γ flux from a nuclear detonation on capacitors, transistors, diodes, and circuits are also examined. It is noted that the problem of transient effects is primarily a circuit designer's problem although the selection of appropriate component parts can be most helpful. (A.G.W.)

39599 AN UNBONDED STRAIN GAGE PRESSURE TRANSDUCER FOR NUCLEAR RADIATION APPLICA-

TIONS. D. A. Carrington (Consolidated Electrodynamics Corp., [Pasadena, Calif.]). 21p. (CONF-631-1)

From Institute of Electrical and Electronics Engineers Region 6 Annual Conference, Salt Lake City, Apr.-May 1964.

An unbonded strain gage pressure transducer, previously developed for the extreme temperatures encountered with radiation environment, was redesigned to meet the requirements of radiation resistance. The transducer utilizes a four-active-arm Wheatstone bridge unbonded strain gage coupled to a force-summing diaphragm. The stipulation of radiation resistance requires that the transducer designer must scrutinize the electromechanical design of an instrument from all aspects. The selection of materials and manufacturing techniques are of primary concern since the end product must remain unaffected by the many effects of nuclear radiation. In some instances, a completely new approach to component design was required because the materials most suitable to radiation are not necessarily compatible with transducer uses. New manufacturing techniques were devised to incorporate a reduction in the required number of operations performed. Processes with more inherent repeatability were also used. Recent reactor tests demonstrated that the transducer is compatible with nuclear radiation. The catastrophic component failures were eliminated and the transducer showed no permanent or residual effects due to the applied radiation. (auth)

39600 A COLD ELECTRON MASS SPECTROMETRIC ION SOURCE. M. K. Testerman, B. E. Gilliland, and E. M. King (Univ. of Arkansas, Fayetteville). 16p. (CONF-649-1)

From 12th Annual Conference on Mass Spectrometry and Allied Topics, Montreal, June 1964.

The performance of resistance-strip electron multipliers as cold-electron ion sources for mass spectrometers is described. (T.F.H.)

39601 IMPROVEMENTS IN A TIME-OF-FLIGHT MASS SPECTROMETER. Robert Morton Mills. 39p. (CONF-649-5)

From 12th Annual Conference on Mass Spectrometry and Allied Topics, Montreal, June 1964. 40p.

A time-of-flight mass spectrometer is described that has a high duty cycle. Ions are accelerated by a high d-c potential, and then pass through a drift tube. At both ends of the drift tube are located short gaps across which r-f sawtooth voltages are applied. The sawtooth voltages have the same frequency, magnitude, and phase at both ends of the drift tube. Mass discrimination is obtained by a detecting instrument behind the drift tube, which measures the "resonant" ions (i.e., the ions that pass through the drift tube with zero energy change). (T.F.H.)

39602 PRESSURE AND TEMPERATURE TRANSDUCERS FOR HIGH TEMPERATURE AND NUCLEAR RADIATION ENVIRONMENTS. S. A. Hluchan (Bourns, Inc., Riverside, Calif.). 8p. (CONF-658-1)

From National Telemetering Conference, Los Angeles, June 1964.

Volumetric transducers for high-temperature (400 to 1500°F) nuclear radiation and other difficult environments are described. A high-temperature fill fluid, NaK, is used to provide a hydraulic transmission link between a seal element contacting the process medium and an electrical output pressure sensor located in a more favorable environment. The design and performance of gage and differential pressure measurement systems utilizing a complete liquid fill are discussed. Also, experimental data relating vapor pressure and temperature for NaK in the temperature range of 1500 to 2000°F are presented in a discussion of a Nak-vapor temperature transducer. (auth)

39603 THE FOCUSING OF HIGHLY CONVERGED DENSE ELECTRON BEAMS. K. Amboss (Hughes Research Labs., Malibu, Calif.). 30p. (CONF-407-4)

From Electro Chemical Society, Toronto, May 1964.

A comparison between Herrmann's optical theory and a pinhole probe study of a highly converged, perveance 0.015×10^{-6} $A/V^{3/2}$, electron beam in a confining magnetic field is prevented, which shows the theory to be obeyed with a good degree of accuracy. The application of the theory to the problem of optimizing the transmission of such thermal beams through long drift tubes is shown to lead to criteria, which differ radically from those prescribed by the laminar theory. (auth)

39604 PULSE TRANSFORMER FOR WELL LOGGING DEVICE. Wilmer A. Hoyer, Roy B. Adams, and Thomas W. Adair, III (to Jersey Production Research Co.). U. S. Patent 3,146,351. Aug. 25, 1964. Filed Dec. 21, 1960.

A pulse transformer is designed for the power supply of a well logging neutron generator. The transformer comprises a small closed ferrite core, primary and secondary coils wound in a multilayered manner on opposite sides of the core, insulation between each layer of the windings, and an atmosphere of SF_6 gas. The neutron generating means (acceleration of D ions onto T target) is coupled to the output terminal of the secondary coil, and a circuit for pulsing the transformer is coupled to the input terminal of the secondary coil and to the output and input terminals of the primary coil. (D.L.C.)

Radiation Detection

Refer also to abstracts 39045, 40517, and 40780.

39605 (AAEC/TM-239) STANDARDISATION OF RADIOISOTOPES AT LUCAS HEIGHTS BY $4\pi\beta$ COUNTING AND $4\pi\beta-\gamma$ COINCIDENCE COUNTING. D. F. Urquhart (Australia. Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales). Feb. 1964. 49p.

The principles of $4\pi\beta$ and $4\pi\beta$-γ coincidence absolute counting methods are discussed, with particular reference to the corrections required. The practical aspects of source preparation, instrumentation, instrumental adjustments, and counting procedure are described in some detail. Examples are given of the standardization of several commonly used isotopes and the results obtained are compared with standards obtained from overseas laboratories. The examples include ^{204}Tl which was standardized in this laboratory while participating in an international intercomparison of this isotope. (auth)

39606 (AAEC/TM-259) A NEUTRON TIME-OF-FLIGHT ANALYSER. P. J. Ellis (Australia. Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales). July 1964. 11p.

A neutron time-of-flight analyzer was developed to accumulate time-of-flight spectra when used in conjunction with a multichannel pulse-height analyzer. Models developed include Mk I, a completely analog device, Mk II, a hybrid device employing both analog and digital techniques, and Mk III, a completely digital system. This

analyzer is suitable for general application for time measurement in the range 10 μsec to 200 msec. (auth)

39607 (AD-600090) DEVELOPMENT OF A LOW-COST GAMMA RADIATION SURVEY METER. Final Report. L. G. Figular (Thomas A. Edison Research Lab. Div. of McGraw-Edison Co., West Orange, N. J.). Mar. 1, 1964. Contract OCD-PS-64-13. 127p.

Results are presented of the investigation and development of a new low-cost Gamma Radiation Survey Meter with a range of 1 to 100 Roentgens per hour. A survey of existing gamma radiation detection transducers is presented with special emphasis on comparing newer semiconductor types with the Edison Radiation Detection type. Theory of operation and characteristics of the Edison Radiation detector are given as well as results of preliminary gamma radiation tests. Tests showed the tube to be fairly linear over a radiation level from 1 R/hr to 100 R/hr with no blocking or saturation up to 2000 R/hr. Energy dependence of the tube could be corrected to be within plus or minus 20% over the range from 80 kev to 1.2 Mev by means of suitable lead shielding. Development of low cost reliable electronic circuitry is described for providing the 800 volt d-c operating voltage from two "D" size flashlight batteries. Prototype design and testing is described and test results for the final prototype are given. Production cost analyses indicate that manufacturing costs for quantities of 25,000 units would be approximately $38 each for the design shown. A preliminary specification covering the new survey meter is presented to cover the design and testing requirements of a production instrument. Finally, recommendations are made which may result in improvement of the detection tube and reduce the cost of the meter still further. (auth)

39608 (AD-600358) INTERIM CALIBRATION AND PROCEDURES FOR GM DETECTOR. Leonard B. Gardner and Bernard Burdick (Naval Civil Engineering Lab., Port Hueneme, Calif.). Mar. 27, 1964. 81p. (TN-559)

The interim calibration of a GM detector is described. Interlaboratory comparison of calibration data was utilized. The geometry, backscatter, self-scatter and -absorption, air and window absorption, window scatter, and shield and holder scatter corrections were determined for weightless point sources upon backless material. Corrections were also determined for spread sources up to 2 inches in diameter. These corrections may be utilized in future experiments to obtain the disintegration rate of activated neutron foil detectors from measurements of the foil counting rate. Such data are necessary when foils of different thickness are utilized as will be done in the study of neutron energy distribution in ducts. (auth)

39609 (AEEW-R-303) THE SENSITIVE DETECTION, IDENTIFICATION AND LOCATION OF SOURCES OF GAMMA RADIATION. K. E. G. Perry and E. George (United Kingdom Atomic Energy Authority. Reactor Group. Atomic Energy Establishment, Winfrith, Dorset, England). Aug. 1963. 21p. (CONF-67-38)

From Health Physics Society 8th Annual Meeting, New York, June 1963.

Equipment for detecting, locating, and identifying very small increases in gamma background is described. The system is based on the use of a sensitive scintillation counter mounted about thirty-six feet above ground level in such a position that a large area can be surveyed. A continuously rotating collimator around the detector is used to indicate the direction of the incident radiation. The output pulses from the detector are taken to both a ratemeter and pulse height analyzer allowing presentation of total count rate and also spectrum analysis of the gamma energies in the radiation. Experiments made by exposing gamma sources at various distances from the detector show that a 5 Curie ^{60}Co source can be detected, located, and identified at a distance of at least 1,108 feet. (auth)

39610 (AERE-R-3360) RADIATION DOSIMETRY TECHNIQUE USING COMMERCIAL RED "PERSPEX." B. Whittaker (United Kingdom Atomic Energy Authority. Research Group. Wantage Research Lab., Wantage, Berks, England). Apr. 1964. 18p.

A commercially available type of dyed polymethyl methacrylate sheet material known as "Red 400" (Perspex) has radiation-coloration properties which can be applied to radiation dosimetry. Irradiation with ^{60}Co gamma radiation in the dose range of 0.1 to 5 megarads results in the appearance of a characteristic absorption band having a peak at 620 mμ wavelength. The color change at doses in excess of 0.5 megarads is easily visible to the eye. In applying the material to dosimetry the perspex is given a two-months aging treatment, and a calibration curve is then drawn up, relating change in absorption coefficient at 635 mμ to dose. At this particular wavelength (635 mμ) the post-irradiation fading effects are at a minimum, and do not normally amount to more than 2% change during the first week after irradiation. Red 400 dosimetry may be applied to the measurement of x and gamma radiation doses. It is particularly useful for monitoring purposes in commercial radiation-processing plants, and is finding application in the Package Irradiation Plant (P.I.P.) at Wantage Research Laboratory. The increase in absorption coefficient at 635 mμ is typically 5.5 inches^{-1} at the nominal ^{60}Co radiation sterilizing dose of 2.5 megarads, resulting in an optical density increase of 0.69 in dosimeters of 0.125 in. thickness. The self-consistency of the dosimeters at this dose level is within ±2%. (auth)

39611 (BNL-876) REPORT ON THE LOGICAL DESCRIPTION OF THE FILM PRESELECTOR SYSTEM FOR THE SPARK CHAMBER READER. G. Schwender, D. Engelberg, R. Schuman, and R. Squires (Brookhaven National Lab., Upton, N. Y.). June 1964. Contract AT-30-2-GEN-16. 26p.

The preselector reader and punch systems for scanning and recording spark chamber data from punched tape are described. The system causes the spark chamber reader to search for a particular film frame and to cause it to be digitized, or to indicate error if the frame cannot be found. (R.E.U.)

39612 (BNL-8249) A PROPOSED 25,000-LITER LIQUID HYDROGEN BUBBLE CHAMBER. (Brookhaven National Lab., Upton, N. Y.). [1964]. Contract AT-30-2-GEN-16. 7p. (CONF-550-48)

From the International Conference on High-Energy Physics, Dubna, USSR, Aug. 1964.

Experiments that could be conducted with this chamber are outlined, and various features of the proposed design that allow for a reasonable cost and construction schedule are discussed. (J.R.D.)

39613 (CPNL-WI-63/3) A CALCULATION OF THE ANGULAR CORRECTION COEFFICIENTS IN AN ANGULAR CORRELATION MEASUREMENT. M. Delabaye (Louvain, Belgium. Université. Centre de Physique Nucléaire). [nd]. 20p.

The results of an angular correlation measurement must

be corrected for the angular resolution of the finite detectors. The numerical values of the correction are given for circular and annular detectors. (auth)

39614 (EURAEC-1027) SOLID-STATE NEUTRON DETECTOR. Quarterly Report No. 2, January 1–March 31, 1964. (Centre d'Étude de l'Énergie Nucléaire, Mol, Belgium). Work Performed under United States–Euratom Joint Research and Development Program. Contract 099-63-10-RDB. 22p. (R-2285)

Results of reactor irradiation and annealing of a diffused SiC barrier counter are given and discussed. The counter was irradiated with doses ranging from 2×10^{14} – 3×10^{16} nvt at about 100°C. The annealing was performed at 200, 300, 450, and 700°C for one hour at each temperature. Properties such as the I-V characteristics, the capacity, the photocurrent and the counting of α particles were measured at room temperature. From the behavior of the forward characteristic it is concluded that the barrier structure changes considerably upon irradiation namely as follows: p–i–n → p–n*–n → p–n*. The forward characteristic changes from 22 to 6 kt behavior at 2×10^{14} nvt. Only a slight increase in slope of the semilogarithmically plotted forward characteristic is observed upon further irradiation. This slope decreases slightly upon annealing. The series resistance increases from 5 kΩ at 2×10^{14} nvt to about 80 kΩ at 3×10^{16} nvt. This series resistance anneals to a large extent. Two annealing steps were observed at 200 and 450°C. The reverse current decreases upon irradiation and increases upon annealing, approaching its pre-irradiation value. The photocurrent is found to decrease considerably upon irradiation, whereas a slight annealing takes place at 200°C only. The pulse height of the α particles of a polonium α source follows about the same behavior upon irradiation as the photocurrent. The peak in the α spectrum shifts to lower collection efficiencies till it disappears in the noise peak at 3×10^{16} nvt. The maximum pulse height was found to decrease in the same way. The α peak could not be reproduced upon annealing, whereas the maximum pulse height did increase slightly. (auth)

39615 (GEMP-298) HIGH-TEMPERATURE EXTENSION OF CONVENTIONAL NUCLEAR SENSORS. Final Report. R. L. Treinen (General Electric Co. Advanced Technology Services, Cincinnati). Aug. 10, 1964. Contract AT(40-1)-2847. 30p.

Development results for extending the operating temperature capability for fission counters to a temperature of 816°C and d-c ionization chambers to a temperature of 538°C are reported. Fission counter operation to a temperature of 816°C is feasible and component construction provides an adequate margin of over-temperature safety. D-C ionization operation at a temperature of 538°C is possible using presently available materials. Reactor power range neutron sensing with d-c ionization chambers can probably be extended to a temperature of 649°C. A major portion of the testing phase of the program was devoted to the evaluation of metal-to-ceramic vacuum seals. The results of testing indicate that vacuum seals are now available that possess outstanding characteristics of reliability, ruggedness, and long-life at temperature. The design and testing results for compatible sensor lead extensions are also described. (auth)

39616 (ML-TDR-64-1) A HIGH-ENERGY PROTON SPECTROMETER UTILIZING SEMICONDUCTOR DETECTORS FOR SPACE PHYSICS EXPERIMENTATION. Henry S. Katzenstein and Frank P. Ziemba (Solid State Radiations, Inc., Los Angeles). Apr. 1964. Contract AF33(616)-8340. 72p. (AD-600156)

High-energy protons are found in primary cosmic radiation, in the Van Allen Belt, and in solar flares. A study of the best methods of observing these phenomena using semiconductor detector techniques developed in the previously reported phases of this program resulted in three basic designs for proton spectrometers for space radiation measurements. These are comprised of (1) the single detector with pulse height analysis, (2) a wide-angle proton spectrometer, and (3) a high angular resolution proton spectrometer. Of these three designs, the third was selected as being capable of providing the best quality of information within the existing state of the art. A design for a ten-channel spectrometer covering the energy range from 24 to 210 Mev in approximately equal logarithmic steps was completed, and on the basis of this design, fabrication was undertaken on an actual prototype spectrometer. Two flight spectrometers were fabricated and environmentally tested. Limited nuclear testing with protons up to 40 Mev verified the energy calibration of the first two channels and verified the calculated angle of acceptance. While size and weight considerably exceeded original estimates, a high degree of reliability and reproducibility was achieved. (auth)

39617 (NAA-SR-9745) ARGON MASS FLOWRATE COMPUTER. K. H. Kline (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Aug. 1, 1964. Contract AT(11-1)-GEN-8. 15p.

A simple analog computer was designed and constructed for the purpose of monitoring the argon mass flow through the piping system of the argon activation neutron flux monitor. The flowrate is proportional to the product of the absolute pressure and the differential pressure across the flowmeter. Accuracy of computations was limited only by the linearity and reproducibility of the transducers used. (auth)

39618 (NAA-SR-Memo-9686) BELGRAPH. Katharine W. Medeiros (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Mar. 25, 1964. Contract [AT(11-1)-Gen-8]. 19p.

Previously published as AMTD-191, January 1963.

The primary function of BELGRAPH is to provide a method of plotting the output of a multichannel pulse-height or time analyzer, and generate CRT output only. (R.E.U.)

39619 (NRL-6150) ANALYSIS OF ERRORS IN BUBBLE CHAMBER TRACK MEASUREMENTS. R. G. Glasser (Naval Research Lab., Washington, D. C.). July 17, 1964. 20p.

The general procedures of propagation of errors were applied to derive error estimates for the quantities derived in the geometrical reconstruction of tracks and points in space from overdetermined stereoscopic measurements. Formulas are given, which are suitable for use in computer programs such as PACKAG. The sources of error explicitly considered are measurement errors and multiple scattering errors. All computations use a Gaussian approximation to the distribution function. (auth)

39620 (PAN-310) APARATURA DLA DOKLADNYCH POMIAROW ROZNICZKOWEGO PRZEKROJU CZYNNEGO NA ROZPRASZANIE ELASTYCZNE CZASTEK ALFA. (An Apparatus for Precise Measurements of the Differential Elastic Scattering Cross Sections for Alpha Particles). A. Budzanovskii, G. Voitsekhovskii, K. Grotovskii,

G. Nevodnichanskii, A. Strzhalkovskii (Polish Academy of Sciences. Inst. of Nuclear Physics, Krakow); S. Mitsek, I. Slizh (Universytet Jagiellowski, Krakow. Fizyozny Institut); and I. Khbashchevskaya (Polish Academy of Sciences. Inst. of Nuclear Research, Krakow). 1964. 8p.

A special scattering chamber for precise measurements of elastic scattering differential cross sections was constructed. Three semiconductor detectors are used; one for angular distribution measurements, and two as beam monitors. Special low-noise electronics for semiconductor detectors was used. This arrangement was used for the measurements of elastic scattering of 24.7-Mev alpha particles on different nuclei. (auth)

39621 (RT/PROT(64)-11) INDAGINE TEORICO-SPERIMENTALE SULLA RISPOSTA DI CAMERE A IONIZZAZIONE ESPOSTE A RADIAZIONE GAMMA PULSATA. (Theoretical-Experimental Research on Response of Ionization Chambers Exposed to Pulsed γ Radiation). M. Ladu, M. Pelliccioni, E. Rotondi (Italy. Comitato Nazionale per l'Energia Nucleare, Rome); and R. Siwicki (Polish Academy of Sciences. Inst. of Nuclear Research, Swierk). May 1964. 14p.

The response of ionization chambers exposed to pulsed γ radiation when the pulses overlap was studied theoretically and experimentally. Particularly the overlap on the chamber of two γ pulses, separated by a variable delay, was studied. The theoretical and experimental plots of the collection efficiency vs the pulses delay, at voltages between 10 and 1000 v, are in good agreement. (auth)

39622 (SSI-9) HALVLEDARDETEKTORER OCH DERAS TILLAMPNINGAR. (Semiconductor Detectors and Their Applications). A. Lauber (Aktiebolaget Atomenergi, Stockholm). June 6, 1962. 38p.

The new and expanding area of semiconductor detectors is reported. A summary is given of the physical theory of semiconductors. Their manufacture, properties, and applications are described. (tr-auth)

39623 (TID-21077) DEVELOPMENT OF A HIGH-SENSITIVITY FAST NEUTRON DOSIMETER. Quarterly Report No. 5, May 1–July 31, 1964. B. H. Chase, R. R. F. Speers, J. M. Swartz, and M. O. Thurston (Phylatron Corp., Columbus, Ohio). Contract AT(11-1)-1226. 17p.

Effort was devoted to diode processing studies to increase the minority carrier lifetime in the base while maintaining low contact resistance, to an analysis of a modification of the readout system that shows promise of a further increase in sensitivity, and to tests on the sensitivity of the fast neutron dosimeter. (N.W.R.)

39624 (UCRL-7905-T) MULTI-CHANNEL ANALYZER (PROGRAMMED DATA PROCESSOR WITH EXTERNAL 8192-CHANNEL MEMORY). Robert Swenson and Calvin Wong (California. Univ., Livermore. Lawrence Radiation Lab.). [nd]. Contract W-7405-eng-48. 5p. (CONF-593-4)

From Conference on the Automatic Acquisition and Reduction of Nuclear Data, Karlsruhe, Ger., July 1964.

The data acquisition and reduction system used with the Livermore 90-in. cyclotron time-of-flight facility is described. Simultaneous accumulation of angular-distribution data from ten spaced detectors requires a minimum of 5000 channels in a pulse-height analyzer. The system is composed of a programmed data processor controlling an 8192-channel external memory (random-access), a dual analog-to-digital converter, and other input-output devices. (R.E.U.)

39625 (UCRL-11372) CONSTRUCTION AND CALIBRATION OF THE SCANNING AND MEASURING PROJECTOR. P. G. Davey and A. J. Schwemin (California. Univ., Berkeley. Lawrence Radiation Lab.). Apr. 22, 1964. Contract W-7405-eng-48. 41p.

The Scanning and Measuring Projector (SMP) is a data-reduction system that digitizes coordinates of particle tracks in bubble-chamber film, and processes them through an on-line computer program to provide information about the nature of the particles in a form useful to the physicist. A detailed account is given of the construction and calibration of the hardware associated with the SMP. Frequent reference is made to a complementary report (UCRL-11154), which gives a general description of the entire system including the digital-computer programs. The complete system digitizes with a positional accuracy of about 3 in 10^5 in a projected field of 50×70 cm. (auth)

39626 (UCRL-11425(Rev.)) OPERATION OF THE SMP DATA-ANALYSIS SYSTEM. William E. Humphrey and Ronald R. Ross (California. Univ., Berkeley. Lawrence Radiation Lab.). June 22, 1964. Contract W-7405-eng-48. 17p. (CONF-550-49)

From the International Conference on High-Energy Physics, Dubna, USSR, Aug. 1964.

Scanning and Measuring Projectors (SMP) were used to measure film from 72-inch hydrogen bubble chamber experiments with 2.5- to 2.8-Bev/c K^- mesons and 2- to 4-Bev/c π^- mesons; their performance is reported. (R.E.U.)

39627 (UCRL-11558) THE 25-INCH LIQUID HYDROGEN BUBBLE CHAMBER EXPANSION SYSTEM. F. Barrera, R. A. Byrns, G. J. Eckman, H. P. Hernandez, D. U. Norgren, A. J. Shand, and R. D. Watt (California. Univ., Berkeley. Lawrence Radiation Lab.). July 8, 1964. Contract W-7405-eng-48. 22p. (CONF-554-8)

From Cryogenic Engineering Conference, Philadelphia, Aug. 1964.

The 25-inch liquid hydrogen bubble chamber at Lawrence Radiation Laboratory is described. Particular emphasis is on the design and performance of the expansion system for the chamber; the chamber is expanded by movement of the top glass on a single-convolution bellows welded to the chamber perimeter. The expansion is controlled with a hydraulic-pneumatic system. The response time of the system is such that Bevatron pulses can be accepted slightly over 150 msec apart, when the chamber is expanded twice for each pulse. (R.E.U.)

39628 (UR-651) THE USE OF GLASS MICRODOSIMETER RODS IN THE DETERMINATION OF ENERGY AND DOSE WITHIN TISSUE. H. D. Maillie and H. Mermagen (Rochester, N. Y. Univ. Atomic Energy Project). Aug. 11, 1964. Contract W-7405-eng-49. 25p.

A technique is described which will predict with a reasonable degree of accuracy (±10%) the dose delivered to any point within a phantom exposed to photon energies from a 1000 Kvp x ray unit or to ^{60}Co γ radiation. The dosages predicted from the combination of the effective energy and the relative response of the lucite-covered glass rods agree within the limits of the accuracy of the technique with those dosages determined by means of a Victoreen R-chamber. (C.H.)

39629 (AEC-tr-6390(p.525-32)) METHODS OF MEASURING BETA-ACTIVE GASES USING COUNTERS. V. V. Bochkarev and V. A. Bazhenov. Translated from Tr. Tashkentsk. Konf. po Mirnomu Ispol'z. At. Energii, Akad. Nauk Uz. SSR, 2: 396-?(1960).

A number of methods of measuring the activity of gaseous beta emitters are described. (M.C.G.)

39630 (AEC-tr-6390(p.553-7)) THE USE OF SCINTILLATION BETA SPECTROMETRY FOR THE DETERMINATION OF SMALL AMOUNTS OF RADIOACTIVE SUBSTANCES IN BIOLOGICAL OBJECTS. D. G. Fleĭshman, V. V. Glazunov, and L. G. Shakhidzhanyan. Translated from Tr. Tashkentsk. Konf. po Mirnomu Ispol'z. At. Energii, Akad. Nauk Uz. SSR, 2: 416-?(1960).

The use of liquid scintillators for measuring radiation from radioactive materials in the organs of humans and animals. To avoid converting the sample to a compound soluble in the liquid scintillator, a technique was developed for measuring the activities of suspensions using scintillating gels. The gel consists of the usual liquid scintillator in which plexiglas is dissolved. Finely ground samples are introduced into a glass cuvette and lubricated with a small amount of liquid scintillator, in order to prevent the formation of lumps. Then the scintillating gel is added to the cuvette, and after energetic shaking, a uniformly distributed suspension of the sample in the gel is formed. The usual circuit is used to register scintillations in the gel. (M.C.G.)

39631 MICROCHAMBERS FOR DOSE-RATE EXPLORATION IN HIGH ENERGY BEAMS. William H. Sutherland (Cardiff Radiotherapy Hospital, Wales). Acta Radiol., 2: 209-18(June 1964).

Methods are described for making sealed microchambers and ionization chambers from readily available material for dose-rate exploration of ^{60}Co and 4 Mev x radiation in water phantoms, together with a simple balancing circuit for comparing the current from such chambers with the much larger current from built-in monitor chambers close to the target. The chambers are suitable for measuring the integrated dose over a wide range with the addition of small screw-on capacitor units. (auth)

39632 AVAILABILITY AND USE OF WHOLE-BODY COUNTERS. F. W. Lengemann (Atomic Energy Commission, Washington, D. C.). Am. Ind. Hyg. Assoc. J., 25: 398-404(July-Aug. 1964).

The types and uses of whole body counters are discussed. Of the three types, the crystal scintillator is favored over the liquid or plastic scintillators. Crystal scintillators are used more for measurement of fallout and for industrial purposes than for clinical purposes. Most whole body counters are used for some purposes of public health and industrial hygiene. An appendix lists organizations in the U.S. having whole body counters. (auth)

39633 A ROTATING DIFFUSION CHAMBER FOR $C^{14}O_2$ DETERMINATION AS APPLIED TO INHIBITOR STUDIES ON MOUSE MAST CELL TUMOR HISTIDINE DECARBOXYLASE. Dorothea Aures and William G. Clark (Veterans Administration Hospital, Sepulveda, [Los Angeles, Calif.] and Univ. of California, Los Angeles). Anal. Biochem., 9: 35-47(Sept. 1964).

A convenient, reliable, and efficient method for the estimation of histidine decarboxylase was developed. The method, which employs CO_2 formation, was compared with methods utilizing histamine formation. The difficulties of measuring histidine decarboxylase by estimating the histamine formed are discussed. By measuring the radioactive CO_2, liberated by enzymic decarboxylation of histidine-1-^{14}C, various compounds were studied for their inhibitor action. (auth)

39634 WHOLE BODY RADIOACTIVITY MONITORS. Boyce Worthley (Univ. of Adelaide). At. Energy Australia, 7: No. 3, 13-16(July 1964).

A whole-body gamma spectrometer installed in a low-level counting laboratory at the Royal Adelaide Hospital is described. Main features of the equipment are: a steel room, a crystal carriage system bearing four NaI crystals, and associated photomultipliers and pulse preamplifiers along the length of a subject lying on a couch. Background measurements made using a distilled water phantom showed no evidence of contamination in the room. Potassium and ^{137}Cs burdens determined in persons from 8 mos to 75 yrs of age showed the general dependence of potassium concentration in the body on age and sex. In fallout contamination studies of subjects examined since 1961, the presence of ^{137}Cs was the only evidence of fallout. The ^{137}Cs burden was most strongly dependent on diet. The monitor was used for retention studies of ^{58}Co-labeled vitamin B12, ^{59}Fe studies of thalassaemia in children, the effect of aldosterone on sodium turnover using ^{22}Na, and calcium metabolism using ^{45}Ca. (H.M.G.)

39635 DETERMINATION OF THE PEAK POSITION OF ENERGETIC RESOLVING POWER AND THE PEAK IMPULSE RATE OF SPECTRA IN DIGITAL FORM. P. Koeppe (Freie Universität, Berlin). Atompraxis, 10: 351-7(Aug. 1964). (In German)

A procedure suggested by Boekelheide for determining the position of a peak was examined theoretically. By using a simple interpolation formula, the peak position can be determined to within ±0.05 channel units. A correction formula was derived for the energetic resolving power and the peak impulse rate; in each case it reduces the margin of error to <1%. (auth)

39636 A SONIC DETECTOR FOR SPARK CHAMBERS. Andre Baumy, Francois Lemeilleur, and Maurice Scherer (Faculte des Sciences, Caen, France). Compt. Rend., 259: 341-4(July 15, 1964). (In French)

Sonic spark chambers require transducers for the detection of the shock wave emitted by a spark. Different types of transducers were tested and an electrostatic probe was perfected. (tr-auth)

39637 THE OPERATION OF A DIFFUSION CLOUD CHAMBER UNDER INTENSIVE REACTOR NEUTRON IRRADIATION. V. Khristov and A. Stanolov. Compt. Rend. Acad. Bulgare Sci., 17: 531-4(1964).

Since there exist no references concerning the operation of a diffusion cloud chamber subjected to an intense reactor neutron flux, the experiments were carried out at the horizontal channels of the IRT-1000 reactor using a specially constructed low pressure fully automatic diffusion cloud chamber. All tests are described in considerable detail. When irradiated by a pulsed intense beam, the cloud chamber was able to operate satisfactorily, and good photographs of proton tracks were obtained in the hydrogen-filled operating volume. No references. (OTS)

39638 RESONANT SCINTILLATION COUNTER. L. Mitrani and L. Levi (Sofia State Univ.). Compt. Rend. Acad. Bulgare Sci., 17: 539-41(1964).

The possibility for the construction of a selective efficiency detector which would register recoilless γ quanta is discussed. The device is essentially the same as the one proposed and constructed previously for detecting the conversion electrons of the resonantly excited ^{119}Sn nuclei except that the Geiger counter was replaced by a scintillation counter. A ^{119}Sn detector which in principle could

operate also with any other isotope with strongly converted levels was constructed and tested successfully. There are 2 Soviet and 1 Western reference. (OTS)

39639 DESIGN OF A PROPORTIONAL COUNTING TUBE WITH INTERNAL ANTICOINCIDENCE SHIELDING. G. Winter, K. Hohmuth, J. Schintlmeister (Zentralinstitut für Kernforschung, Rossendorf, Ger.). Exptl. Tech. Physik, 12: 141-51(1964). (In German)

The construction of a proportional counter with inner anticoincidence shielding (multiwire counter) and the electronic equipment belonging with it are described. For checking the function of the spectrometer, measurements were made on a solid preparation of ^{181}W and on a gaseous ^{37}Ar source. The electron capture ratio for ^{37}Ar was determined to be $P_L/P_k = 0.102 \pm 0.003$ and compared with the results of other authors. (tr-auth)

39640 THE SCINTILLATION COUNTER AS DETECTOR FOR A SHORT-LENS SPECTROMETER. M. Deutscher, H. Graber, J. Schintlmeister, and R. Weibrecht (Zentralinstitut für Kernforschung, Rossendorf, Ger.). Exptl. Tech. Physik, 12: 160-73(1964). (In German)

The characteristics of scintillation counters were investigated with regard to their use as detectors in a magnetic short-lens spectrometer. Measurements were made of the light yield of some polystyrol scintillators. The dependence of the average pulse height and the resolution possibility on the reflector material and the dimensions of the scintillator as well as the parameters of the secondary electron multiplier was determined with 2-phenyl-5-diphenyl-oxadiazol scintillators. From that assumptions could be made concerning the conversion of the light in the scintillator and the photoelectrons in the multiplier. The installation of the scintillation detector in a short-lens spectrometer without light conductor is described. Compensation of the magnetic field of the spectrometer in the region of the detector is considered. (tr-auth)

39641 THE DETECTION OF HIGH-ENERGY PARTICLES. D. V. Bugg (Cambridge Univ., Eng.). ICSU (Intern. Council Sci. Unions) Rev. World Sci., 6: 7-17 (Jan. 1964).

The principles and general features of spark chambers, bubble chambers, Cherenkov counters, and scintillation counters are reviewed. Some specific applications are briefly considered, as well as neutron detection. (D.C.W.)

39642 ELECTRONIC DEVICE FOR CONTINUOUS RECORDING OF α EMISSION BY RADIOACTIVE GASES. A. F. Vinogradov, S. P. Rybak, and M. D. Shibanova. Izmeritel. Tekhn., No. 5, 53-6(May 1964).

An ionization chamber and its associated circuitry for continuously recording α emission by radioactive gases are described. The chamber is designed for gas temperatures up to 150°C and registers activities of $10^{-13} - 10^{-14}$ Curie. (C.E.S.)

39643 TERMINOLOGY PROBLEMS IN NUCLEAR SPECTROSCOPY. E. L. Stolyarova (Inst. of Physics and Engineering, Moscow). Izv. Vysshikh Uchebn. Zavedenii, Fiz., No. 2, 8-16(1964). (In Russian)

A short review is made of the concepts, aspects, and terminology for describing the characteristics of spectrometers irrespective of the type of radiation. (R.V.J.)

39644 A RADIOTHERMOLUMINESCENT DOSIMETER. II. THERMOLUMINEMETERS. Zdeněk Spurný (Inst. of Radiological Dosimetry, Czechoslovak Academy of Sciences, Prague). Jaderna Energie, 10: 246-51(1964). (In Czech.)

Experience gained with thermoluminimeters (instruments for checking light emission intensity in the dependence on heating the solid) is described. The description is given with respect to the fact that these instruments till now are nowhere commercially produced. (P.C.H.)

39645 AN AUTOMATIC RECORDER OF THE SPARK CHAMBER. Shuji Fukui, Satio Hayakawa, Ryoichi Kajikawa, Ken Kikuchi, and Kunikazu Mori (Nagoya Univ., Japan). Japan. J. Appl. Phys., 3: 400-8(July 1964).

An automatic digitizing-recording system of the spark chamber by means of television vidicon cameras is constructed. It is possible to record two spark columns in one gap simultaneously, and two cameras are used to define the position of a spark column. One picture is decomposed into 200 horizontal sweep lines in one vertical sweep; among them 40 sweeps are arbitrarily selected for the digitization according to the structure of the chamber. The digitization area (67% of the sweep length) is divided into 1000 scales and the position of the spark is represented by the 3 digital numbers. The capacity of the memory is just enough to memorize a set of steroscopic pictures of an event. At present, the position of the spark is determined with an error of scale 2, the resolving power of two lines is about scale 7, and the linearity between the geometrical position and the digitized result is good. (auth)

39646 A DIFFERENCE METHOD FOR SCINTILLATION COUNTING OF SMALL PULSES. G. Brunner, M. Geisler, and K. Renker (Institut für Angewandte Radioaktivität, Leipzig). Kernenergie, 7: 513-20(June-July 1964).

An apparatus fit for an automatic subtraction of alternately registered pulse-height distributions was developed and applied to investigations on smallest pulses. The transition of light from scintillator to multiplier can be periodically interrupted by means of a shutter. By subtraction of the distribution corresponding to the closed shutter from that corresponding to unrestrained light transition, the multiplier noise can be taken into account with high accuracy. The phosphorescence observed in the liquid-scintillation measurements showed a decay slowed down by previous exposures. The noise distributions are described as "cracked exponentials" that did not harmonize with calculations of other authors, based on a Poisson distribution of the electron numbers in a single secondary emission process. (auth)

39647 A NEW METHOD FOR REDUCTION OF THE COMPTON DISTRIBUTION IN GAMMA-RAY SCINTILLATION SPECTROGRAMS. M. Geisler and G. Brunner (Institut für Angewandte Radioaktivität, Leipzig). Kernenergie, 7: 521-7(June-July 1964).

A simple difference method is described for reducing the Compton distribution in gamma scintillation spectrograms. The method employs a single detector. The calculations were carried out by the Monte Carlo method. The selection of special scattering angles, interaction points, etc., for each event is performed by employing random numbers, distributed so that in totality they give the right differential cross section, absorption laws, etc. Some results are presented to illustrate the applicability of the technique. Theoretical foundations of the method are reported, especially the calculation of the photofraction for eccentric incidence into the crystal. (M.C.G.)

39648 THERMOLUMINESCENT DOSIMETRY WITH LITHIUM FLUORIDE. M. Frank, H.-J. Dubrau, H. Lingertat, and L. Herforth (Technische Hochschule, Dresden). Kernenergie, 7: 570-3(June-July 1964).

The Lumimeter II, a thermoluminescent dosimeter, is described. This instrument utilized the thermoluminescent characteristics of lithium fluoride and provides readings accurate to within 3% in the 1 to 10^4 rad range. The readout instrument of the device, the production of lithium fluoride dosimeters, the properties of LiF dosimeters, and the applications of LiF thermoluminescent dosimetry are reviewed. (OTS)

39649 THE EFFECT OF HEAT TREATMENT ON THE QUALITY OF NaI(Tl) SCINTILLATORS. László Berkes and Rudolf Voszka (Inst. of Medical Physics, Budapest). Magy. Fiz. Folyoirat, 12: 59-61(1964). (In Hungarian)

In order to determine the behavior of scintillation crystals exposed to extended heat treatment, a number of crystals of varied quality were mounted and examined by means of a single-channel analyzer. The amplitude was determined by comparison with a reference crystal and the resolution by means of a Cs source. The precision of the measurements was ±1%, mostly because of the specific uncertainty due to the instrument and problems arising from mounting the crystal. Before each treatment, the crystals were removed from their mounts; then they were treated in an electric furnace and were allowed to cool to room temperature in the furnace, before being remounted and retested. In the first series of tests, the crystals were heated to temperatures between 200 and 550°C, increasing the temperature by increments of 100° and soaking the crystals for 6 days at each temperature. It was found that the resolving power changed only slightly but the pulse amplitude was enlarged. Treatment at temperatures exceeding 600°C resulted in the opacity of the crystals and the worsening of their characteristics. This behavior is explained by assuming that some of the Tl^+ ions became first inactive, forming complexes with the impurities at the grain boundaries. The heat-induced dissociation of these complexes liberates the ions, thus increasing the number of the active centers. At temperatures near the melting point, where the mobility of the ions is increased, the water diffusing into the crystal causes opacity, as a result of the $NaI + H_2O = HI + NaOH$ and $2HI = H_2 + I_2$ reactions. It is recommended to limit the annealing of the crystals to a treatment for 200 hours at a temperature not exceeding 600°C. (TTT)

39650 THE TAKING OF γ-SPECTRA BY MEANS OF A SCINTILLATION SPECTROMETER. Daniel Voedroes. Magy. Fiz. Folyóirat, 12: 73-9(1964). (In Hungarian)

The γ spectra are of great practical importance for determining the composition of the emitting sources and the purity of radioactive preparations; they are widely used in activation analysis. Scintillation counters were used as the detecting element; they have electron multiplication factors ranging between 10^6 to 10^7. The amplitude analyzer consisted of a single-channel linear amplifier, 2 threshold discriminators, and a coincidence counter. The various energy-transformation factors have a statistical character, yielding a bell-shaped, rather than a pure line spectrum. The pulse scattering, determining the resolution of the system, is defined by the half-width value of this curve. Location of the photopeak which is characteristic for the γ-energy, depends on the degree of amplification used with the system. The 661-kev ^{137}Cs line was used for standardization because it has a long half life and an average energy. The practical problems encountered in the taking of the spectra are outlined. (TTT)

39651 AN EMERGENCY PERSONAL DOSIMETER. Martonne Bekes and Sandor Deme. Magy. Tud. Akad. Kozp. Fiz. Kut. Int. Kozlemen., 12: 247-56(1964). (In Hungarian)

An emergency gamma- and neutron dosimeter was constructed. The badge contains a photographic film and a set of activation detectors—Au, S, P. Calculations were made considering a hypothetical neutron spectrum combined of thermal, epithermal /1/E/, and fission neutrons. Doses ranging 5–1000 rads can be measured to 10–20% accuracy. (auth)

39652 ABSOLUTE MEASUREMENT OF THE ACTIVITY OF RADIATION SOURCES. II. METHOD OF FIXED SOLID ANGLE FOR THE DETERMINATION OF THE ACTIVITY OF β-SOURCES. V. Voicu and V. Codita. Metrol. Apl. (Bucharest), 10: No. 1, 24-8(1963). (In Romanian)

Because of their simple, rugged construction, detectors with a fixed solid angle are widely used for β counting. In view of the isotropic emission of the radiation by the source, the total number of the emitted β particles may be calculated quite simply from the count obtained under a specified angle. The necessary corrections include consideration of the time of resolution, the background, efficiency of the counter, absorption and scattering by air, back scattering, self-absorption, and self-scattering, etc. Activities of the order of 10^{-5} to 10^{-8} C may be measured by such an instrumental method. It was attempted to evaluate and to reduce the need for corrections. It is recommended that the source be placed at 2 to 3 cm from the window of the counter. The angular correction should be determined by means of a standard source. A count rate between 20 and 50 pulses/sec is considered best for these systems. Special attention should be given to shielding against γ radiation. The thickness of the window must be determined from calibration runs with various thicknesses. It was concluded that the method is useful for the determination of β-emitting isotopes, if the required precision lies between 5 and 10%. (TTT)

39653 UTILIZATION OF DECATRONS IN APPARATUS FOR MEASURING NUCLEAR RADIATION. V. Constantinescu. Metrol. Apl. (Bucharest), 10: No. 1, 29-33(1963). (In Romanian)

A new type electronic tube, possessing a cold anode and involving discharge in gas, was found useful in the design of nuclear measuring devices. The central anode of the tube is surrounded symmetrically by a series of cathodes; a switching device allows the discharge between the anode and the desired cathodes to vary. The discharge pulse is supplied by a special circuit. Depending on the type of the tube used, one or more pulses are required to obtain a signal on the recording cathode. One pulse may trigger the next stage, operating at ten times higher or lower frequency, whence the name, –decatron, of the instrument. The anodic voltage should be stabilized, in order to reduce the oscillations of the anode current. The rapid counting rate and direct readability of these instruments make them useful in analytic computers; when incorporated in radiation counters, they contributed to the improvement of the instruments. A new Soviet counter, the PS-5M is able to count 10^5 counts/sec, with a total capacity of 10^6 pulses, with direct reading. Details of measuring instruments incorporating these devices are given. (TTT)

39654 ABSOLUTE MEASUREMENT OF ACTIVITY OF RADIATION SOURCES. III. COUNTING METHOD IN 4π GEOMETRY. V. Voicu, V. Codita, and D. Cismas. Metrol. Apl (Bucharest), 10: 181-6(1963). (In Romanian)

The 4π-geometry is most widely used for calibrating β and α-emitting radionuclides. The 4π-counter consists of

2 identical spherical or hemispherical counters, separated by a very thin common wall, on which the source to be measured is placed in such a way that each emitted particle that is not at sorbed in the support, passes through the sensing volume of one or the other counter. The 2 halves of the counter have anodes connected in parallel. G-M and proportional counters may be used. In order to be able to distinguish between background noise and the signal, the amplification factor must reach about 10^4, requiring the application of 1600 v for Ar–methane, or 2500 v for pure methane counters. To compensate for errors, corrections must be made for dead time, background, self-absorption, and absorption in the structural components. For α-emissions, no correction is required because there are no low-energy particles and the detection threshold is high. The excellent counting efficiency for soft x rays make the 4π scintillation counters very useful for the calibration of sources that disintegrate by electron capture. (TTT)

39655 SOME PROPERTIES OF UNSATURATED IONIZATION CHAMBERS. G. A. Gumanskii. Nauchn. Tr., Tashkentsk. Gos. Univ., No. 221, 163-75(1963). (In Russian)

The effect of collector voltage on ionization current was studied for an ionization chamber with variable electrode spacing. Movable electrodes of aluminum, copper, and lead were used. The chamber was exposed to x radiation of 0.50 Å both unfiltered and filtered by aluminum, copper, or lead. For given voltages below saturation, the ionization current generally passed through a maximum as the electrode spacing was increased. This was caused by a sharp decrease in the effectiveness of the chamber with increasing depth. (M.C.G.)

39656 DETECTION OF BREMSSTRAHLUNG OF RADIOISOTOPE BETA RADIATIONS BY SCANNING. Kenji Takeshita and Shigeki Momii (Kyushu Univ., Fukuoka, Japan). Nippon Igaku Hoshasen Gakkai Zasshi, 23: 308-12 (June 25, 1963). (In Japanese)

Using ^{32}P sources of 4 mm in diameter the limit of detection in the scintigram was studied. With the filter in front of the counter, 500 μC of ^{32}P could be detected in the scintigram for the source at the depth of 8 cm; 100 μC was barely detectable at the depth of 4 cm using a 1 × 1 in. NaI crystal and cylindrical collimator. But 2.4 μC of ^{32}P could be detected at 4 cm depth using a 2 × 2 in. NaI crystal with semi-cylindrical cone and background eraser. Attempts were made at cross-scanning using a slit type collimator, the 1 × 1 in. NaI crystal and the usual scanning unit. The scintigrams obtained were better than the normal ones using the cylindrical hole; 25 μC of ^{32}P was detectable at the depth of 4 cm in this method. This cross-scanning method requires laborious handling but should be investigated for the detection of the secondary effects of radioisotopes, such as Bremsstrahlung. (B.B.B.)

39657 CONSTRUCTION AND PROPERTIES OF A DOUBLE FOCUSING IRON β-SPECTROMETER WITH FIELD SHAPE CONTROL. T. Y. Chen, O. Huber, J. Kern, L. Schellenberg, B. Walthard, and H. Wild (Universitat, Freiburg i. B.). Nucl. Instr. Methods, 29: 181-204(Oct. 1964). (In German)

A special construction of a double focusing iron β spectrometer, with a normal radius of 30 cm, was designed, which can be taken as a combination of the two classical models, namely the core-in-the-center and the inside-out type, with subdivided induction coils. The advantage of this construction is that the field shape produced can be varied by changing the ratios of the currents in the separate sub-coils, so that it may be made to fit the theoretical proposal better than the one produced by a simple iron yoke. Furthermore, it may be reasonably expected that the fringing effect would be smaller in such a construction than in the usual design. Construction details, such as the form of pole surfaces, coil dimensions, baffle shape, detector and source arrangements, current supply and field stabilization are described. With the aid of Hall plate measurements, the field shape was made to fit as well as possible to the theoretical curve, given by $H_z(\rho) = H_0 (1 - 0.5\ \rho + 0.375\ \rho^2 - 0.299\ \rho^3)$. Finer adjustments were carried out, using different performance criteria, which respond more sensibly to the changes of field shape. With the optimum field chosen, combinations of initial conditions were studied experimentally and compared with the theoretical prediction, with a view to obtain maximum luminosity for a given resolution. At an impulse resolution setting of 0.1%, a source of 1 × 20 mm^2 and a solid angle of 0.5% can be used. The highest resolution as yet achieved is 3.6×10^{-4} with a source of 0.2 mm width. (auth)

39658 SINGLE GAP BETA RAY SPECTROMETERS. K. M. Bisgard (Univ. of Aarhus, Denmark). Nucl. Instr. Methods, 29: 213-30(Oct. 1964).

Constructional details of a single gap beta spectrometer utilizing a toroidal, $H = H_0/r$ field are presented. The diameter of the pole plates is 50 cm and the angle between the plates is 20°. The geometrical solid angle available amounts to 2.8%. The distance between source and focus is 340 mm. The average value of dispersion amounts to about 900 mm. An electron energy range from about 5 kev up to about 3 Mev is accessible. The instrument can be used also for measurements of coincidences between energy selected electrons and photons, beta or alpha particles, respectively. It is particularly suited for the measurement of angular correlations. Two instruments can be connected for electron-electron coincidence measurements. The properties of the spectrometer for external conversion measurements seem favorable. The procedure used for shaping the pole faces is described. Corresponding values of transmission and resolution are found for different parts of the gap. At resolution settings of 0.3, 0.5, 1, and 2% values of transmission equal to 0.4, 0.9, 1.4, and 1.8%, respectively, can be obtained. Some properties related to the performance are discussed, particularly the effects of fringing fields. Examples of applications are given. (auth)

39659 STUDY ON AN ENERGY ANALYZER FOR RELATIVISTIC ELECTRONS. (SPHERICAL CONDENSER). J. Kessler and N. Weichert (Technische Hochschule, Karlsruhe, Ger.). Nucl. Instr. Methods, 29: 245-56(Oct. 1964). (In German)

A spherical electrostatic analyzer was constructed for use in scattering experiments with relativistic electrons. The properties of the instrument were investigated in the energy range 50–250 kev. At various electron energies resolution, beam width, and energy dispersion were measured. The experimental data agree with the results of calculations based on a relativistic theory of the spherical analyzer developed by N. Ashby. Some features of the analyzer (grounding of the outer sphere and particle detection outside the focus) cannot be treated by the original theory. Therefore an expansion of the theory was carried out, which is presented. Further measurements were made on effects that may disturb the performance of the instrument. (auth)

39660 OPERATION MECHANISM OF THE TRACK SPARK CHAMBER. G. E. Chikovani, V. N. Roinishvili, and V. A. Mikhailov (Inst. of Physics, Academy of Sciences, Georgian SSR). Nucl. Instr. Methods, 29: 261-9(Oct. 1964).

A new track detector of charged particles, called the track spark chamber, is described. In the track chamber the development of the streamers induced by primary track electrons is cut off at an early stage and the particle track is obtained as a succession of luminous centers-streamers localized along the particle trajectory. The rms deviation of a luminous center from the particle trajectory is 2 mm parallel to the direction of the electric field and 0.3 mm perpendicular to it. The track chamber registers equally well the tracks of single particles and large groups of particles and also the tracks of particles generated within the chamber. A statistical model is proposed to explain the operation mechanism of the chamber. Theoretical conclusions are in satisfactory agreement with experimental data. (auth)

39661 STREAMER CHAMBER. B. A. Dolgoshein (Inst. of Engineers-Physicists, Moscow), B. U. Rodionov, and B. I. Luchkov. Nucl. Instr. Methods, 29: 270-6(Oct. 1964).

A new type of discharge track chamber, a streamer chamber, is described. The main feature is space recording of particle trajectories irrespective of their position in the chamber. The streamer chamber is a result of the development of spark and discharge chambers and possesses all their advantages. The mechanism of the track formation is discussed. The chamber operation with different gas fillings was checked. (auth)

39662 HYBRID LOW NOISE CHARGE SENSITIVE PREAMPLIFIER. J. Hahn and R. Mayer (Columbia Univ., New York). Nucl. Instr. Methods, 29: 277-81(Oct. 1964).

A hybrid low noise charge sensitive preamplifier suitable for use with solid state radiation detectors is described. The preamplifier is completely transistorized except for a Nuvistor input stage. The preamplifier approaches the performance of an all vacuum tube preamplifier previously reported but is smaller, dissipates less power and uses power supplies compatible with associated all transistorized equipment. Typical open loop gains of 20,000 are achieved. Noise, for zero external capacitance averages 450 rms electrons. Rise time, for a closed loop gain of 100 is approximately 50 ns. Linearity and gain sensitivity data are given. (auth)

39663 METAL-SEMICONDUCTOR CONTACTS FOR SOLID STATE RADIATION DETECTORS. P. E. Gibbons (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nucl. Instr. Methods, 29: 289-92(Oct. 1964).

The mode of operation of the gold silicon surface-barrier diode is discussed. Certain experimental observations pertaining to this contact are given. The roles of oxygen and water in producing good reverse characteristics are suggested to be as passivating agents in solving the problem of dangling bonds. (auth)

39664 EXAMINATION OF THE TIME BEHAVIOUR OF PHOTOMULTIPLIERS WITH THE AID OF A MULTICHANNEL TIME ANALYSER AND A LIGHT PULSE GENERATOR (INVOLVES PHOTOMULTIPLIERS K 14 FS 50, 56 AVP, FEU-36). M. Bonitz, W. Meiling, and F. Stary (Central Inst. of Nuclear Research, Rossendorf, Ger.). Nucl. Instr. Methods, 29: 309-13(Oct. 1964).

In place of a scintillator, a light pulse generator is utilized which simultaneously produces light pulses and electric pulses. The electric pulse of the generator and the output pulse of the individual multiplier unit are fed into a time-to-pulse-height converter. Half-width $2\tau_0$ data of the obtained resolution curves serve as a measure for the time jitter of the multiplier. Individual adjustment of the voltage divider was employed for every multiplier unit. This involved the types K 14 FS 50 FEU-36, and 56 AVP, with six units examined of each type. Time resolution of type K 14 FS 50 was better by about 30 percent compared with type FEU-36 and by about 40 percent compared with type 56 AVP. Prepulsing was observed with type 56 AVP and type FEU-36, i.e., pulses occurring at the multiplier output before the arrival of the main pulse. In consequence the resolution curve becomes asymmetric and the time resolution suffers seriously. With type K14 FS 50 no prepulsing could be detected. (auth)

39665 PREPULSES IN PHOTOMULTIPLIERS. M. Bonitz, W. Meiling, and F. Stary (Central Inst. of Nuclear Research, Rossendorf, Ger.). Nucl. Instr. Methods, 29: 314-18(Oct. 1964).

Prepulses occur in multipliers type 56 AVP and type FEU-36 which, with the 56 AVP units, arrive at the anode about 4 to 10 ns before the main pulse reaches there. These prepulses originate in the focusing system. Subjecting the photocathode of the multipliers to constant height light-pulses, prepulses could be observed oscillographically at the multiplier anode and their influence studied on the shape and half-width of coincidence curves. Attainable time resolution is seriously impaired by the wide time and height fluctuations of the prepulses, because this affects the initial part of the multiplier output pulse usually utilized for time measuring. If the high-voltage level exceeds 2.2 kev prepulsing in 56 AVP units results in asymmetric coincidence curve formation, when lighted with light-pulses which are equivalent to ^{60}Co γ radiation in stilbene. Resolving time impaired by the effect of prepulses finds no mention in the theories put forward e.g., by Gatti and Svelto. Comparison of theoretical data with experimental results is thus made difficult. (auth)

39666 AN INSTALLATION FOR PURIFICATION OF GASES FOR SPARK CHAMBERS. J. Duflo (CERN, Geneva). Nucl. Instr. Methods, 29: 319-21(Oct. 1964). (In French)

An installation for the purification of neutral gases, in which vapor and air are trapped by a molecular filter and by zirconium metal, has improved the performance of a spark chamber of large volume and has enabled it to reach 100% efficiency. (auth)

39667 APPARATUS FOR THE MEASUREMENT OF STARS WITH A DOUBLE CENTRE IN NUCLEAR EMULSION. S. J. Bosgra and A. G. Tenner (Universiteit, Amsterdam). Nucl. Instr. Methods, 29: 322-4(Oct. 1964).

In order to determine the mutual position of the prongs of a star, an apparatus was constructed for the measurement of the X- and Y-coordinates of the grains of the prongs near their origin. By calculating best fitting lines through the coordinates it is possible to detect double centered stars with a separation of 0.25 μm. (auth)

39668 COINCIDENT AND RANDOM SUMMING IN SCINTILLATION SPECTROMETERS. T. J. Kennett, W. V. Prestwich, and G. L. Keech (McMaster Univ., Hamilton, Ont.). Nucl. Instr. Methods, 29: 325-32(Oct. 1964).

The problem of coincident and random summing in scintillation spectrometers was investigated. Detailed examination of the random-sum mechanism has permitted the design of experimental and computational techniques for the

correction of this effect. The distortion of data by random summing is discussed for both γ and β spectra. (auth)

39669 QUASI-ELASTIC (p,n) ANGULAR DISTRIBUTIONS: INSTRUMENTATION. B. D. Walker, J. D. Anderson, J. W. McClure, and C. Wong (Univ. of California, Livermore). Nucl. Instr. Methods, 29: 333-6(Oct. 1964). (UCRL-7612)

The modifications of the Livermore 90-in. cyclotron time-of-flight facility necessary for the measurement of quasi-elastic (p,n) angular distributions are discussed. These modifications include: the construction of shielded 10-m flight paths at 3, 30, 60, 90, 120, and 135°; the installation of an additional bending magnet and auxiliary equipment to bend the proton beam such that it strikes the target at an angle of 18° to the normal beam line, thus effectively doubling the number of angles for which measurements can be made; modification of the electronic system such that all detectors can record data simultaneously. Future expansion to include 10-m flight paths in 15° intervals, which will make possible measurements from 0 to 157.5° in 7.5° steps and the electronics necessary for this more complex system are discussed. (auth)

39670 SPEED AND RANDOM FLUCTUATIONS IN THE INVERSE TIME INTERVAL TYPE OF LINEAR RATEMETER. C. H. Vincent (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). Nucl. Instr. Methods, 29: 337-40(Oct. 1964).

The inverse time interval type of linear ratemeter was used successfully for the measurement of varying rates of regular pulses, for which it has some definite advantages. The possibility of using it similarly for randomly time pulses is examined. It is necessary to base the reading on the sum of a number of consecutive pulse intervals, rather than a single pulse interval, in order to reduce the statistical fluctuations to a usable value. No advantage is found over the standard type of diode pump linear ratemeter for random input pulses. (auth)

39671 A LOW ENERGY π^+ DETECTION SYSTEM, FOR USE IN INTENSE ELECTRON AND γ-RAY BACKGROUND CONDITIONS. D. W. G. S. Leith, E. M. Lawson, R. Little, and G. M. Lewis (Glasgow Univ.). Nucl. Instr. Methods, 29: 341-4(Oct. 1964).

A scintillator counter technique was developed to detect low energy π^+ mesons, (~4–40 Mev), in an intense background of electrons and γ rays at forward angles. The identification of a π^+ meson required the observation of the characteristic decay ($\pi^+ \rightarrow \mu^+ + \nu$ in 2.55×10^{-8} sec) of the pion, together with the fulfillment of restrictions on the energy loss and total energy of the particle under examination. The system was used to investigate π^+ meson photoproduction cross sections at 30° laboratory angle in the γ ray energy region (155–190) Mev. (auth)

39672 OXIDE-PASSIVATED SILICON p-n JUNCTION PARTICLE DETECTORS. W. L. Hansen and F. S. Goulding (Univ. of California, Berkeley). Nucl. Instr. Methods, 29: 345-7(Oct. 1964). (UCRL-11227)

A manufacturing process for passivated p-n junction detectors is described. The role of oxygen during the diffusion process is emphasized; careful control of oxygen is a feature of the process. The results obtained justify the belief that this technique may result in the availability of cheap high-quality detectors, which may make possible the construction of large detector arrays. (auth)

39673 NUCLEAR EMULSIONS AND n-p ELASTIC SCATTERING. R. Fox and A. Suhami (Israel Inst. of Tech., Haifa). Nucl. Instr. Methods, 29: 348-50(Oct. 1964).

A method is described using nuclear emulsions to obtain small angle neutron-proton elastic scattering data in the energy region of incident neutrons of ~600 Mev. The importance of small angle n-p data is discussed. Sources of background in the nuclear emulsion technique and their effects are analyzed. (auth)

39674 THE USE OF NUCLEAR EMULSION IN ASSOCIATION WITH SPARK CHAMBERS. B. G. Duff (University Coll., London), D. A. Garbutt, and W. T. Toner. Nucl. Instr. Methods, 29: 351-5(Oct. 1964).

Spark chambers were placed above and below a nuclear emulsion stack exposed to cosmic radiation. The direction of the cosmic rays and their entry points into the emulsion stack were calculated from their tracks in the spark chambers. Tracks were found in the emulsion whose angular co-ordinates agreed with those predicted to ±0.3° and with co-ordinates of entry agreeing to 0.4 mm. The number of confusing tracks was found to be insignificant. Possible applications of the joint use of the emulsion and spark chamber techniques are discussed. (auth)

39675 PILE-UP DETECTION CIRCUIT. G. Bertolini, V. Mandl, and G. Melandrone (C.C.R. Euratom, Ispra, Italy). Nucl. Instr. Methods, 29: 357-9(Oct. 1964).

Pile-up detection circuits which reject two or more superposed or shortly distant events in time are discussed. The circuit described inhibits the analysis of successive distorted pulses and rejects the first one when pile-up occurs on its leading edge. A maximum dead time of 500 μsec can be introduced and all signals spaced by less than 5 μsec are canceled. Applications of the instrument are illustrated. (C.E.S.)

39676 ANALYSIS OF GAMMA PULSE-HEIGHT SPECTRA WITH SEVERAL ADJACENT COMPONENTS. Roland Engfer (Technische Hochschule, Darmstadt, Ger.). Nukleonik, 6: 199-201(July 1964). (In German)

A method for analyzing the energy and relative intensities of complex gamma pulse-height spectra obtained with a NaI crystal is described. This method uses only a single calibration spectrum. Examples of the method and its accuracy are given. (auth)

39677 STATISTICS OF THE ELECTRON-MULTIPLICATION PROCESS IN PROPORTIONAL COUNTERS. J. Byrne (Univ. of Edinburgh). Proc. Roy. Soc. Edinburgh, A, 66: 33-41(1961-62).

Theory of the probability distribution of the total number of electrons in the avalanche produced by the release of a single electron in the gas of a proportional counter is studied. The disagreement between existing theory and experimental results is discussed, and a new theory is proposed, based on the fact that fluctuations in the number of electrons at a given point in the avalanche are accompanied by fluctuations in the average electron energy. This aspect of the problem is incorporated directly into a simple one-dimensional model of the multiplication process, and the resulting distribution function has a mathematical form in agreement with that observed experimentally. The fluctuation in the number of electrons predicted by this theory is not constant, but is determined by a parameter which, for large mean values, is essentially the mean fraction of electrons in the avalanche having energies above the ionization energy of the counter gas. Limits on the variation of this parameter are obtained by calculations of the mean values using a particular two-

dimensional model, in which electrons are divided into two classes according as they have energies above, or below, the ionization energy. The experimentally observed fluctuation lies within the predicted range and close to the lower limit; it is concluded that there is little scope for improvement in the resolution to be obtained from the conventional type of proportional counter. (auth)

39678 DETERMINATION OF DOSE AND ENERGY OF X RADIATION USING DOSIMETRIC FILM. T. Musialowicz (Central Laboratory for Radiological Protection, Warsaw). Symp. Tech. Zagadnien Ochrony Promieniowaniem, Warsaw, 96-102(1962). (In Polish)

On the basis of the film-darkening method used in the West German Republic in radiation monitoring, a modified method for the determination of the correction factors and the radiation energy is presented. The method gave higher accuracy in energy and dose determinations. The relative errors were about ±30% in the evaluation of total dose for radiation energies up to 200 kv. (tr-auth)

39679 PERSONAL RADIATION PROTECTION CONTROL OF NEUTRONS. W. Kiesewetter (Amt fur Kernforschung und Kerntechnik Arbeitsstelle, Dresden). Symp. Tech. Zagadnien Ochrony Promieniowaniem, Warsaw, 103-15(1962). (In German)

Energy-dependent relative biological effectiveness (RBE) and the values derived for the highest permissible body radiation burden and the different reading possibilities for neutrons of various energies determine, in addition to the general requirements for personal dosimeters, their construction and region of applicability. Film dosimeters for neutrons in the thermal and fast energy range that can be used in routine monitorings and that satisfy, within certain limitations, the given specifications are described. (tr-auth)

39680 PROBLEMS AND METHODS OF PERSONAL DOSE MONITORING. F. Wachsmann (Universitat, Erlangen, Ger.) and M. Wolski. Symp. Tech. Zagadnien Ochrony Promieniowaniem, Warsaw, 131-52(1962). (In German)

The increased use of artificial radiation sources and the growing knowledge of the possible radiation injuries have brought greater significance to the monitoring of personnel dose. As a function of the utilization purpose, different requirements with respect to the measurement range, type of radiation, radiation energy, accuracy, and characteristics are placed on personnel monitoring. The principal methods are discussed under these aspects. Analyses carried out by comparison of the results shows the superiority of film dosimetry. (tr-auth)

39681 STUDY OF SENSITIVITY OF X-RAY FILMS AND INTENSIFYING SCREENS USED FOR MEASURING INDIVIDUAL X AND GAMMA RAY DOSE AT DIFFERENT ENERGIES. J. Domanus (Electrotechnical Inst., Industrial Radiology Establishment, Warsaw). Symp. Tech. Zagadnien Ochrony Promieniowaniem, Warsaw, 153-71(1962). (In Polish)

Measurements of personnel dose have been carried out for some years at the Electrotechnical Institute in Warsaw using dosimetric film. For the purpose of determining which of the various x-ray films are best suited for such measurements, sensitivity measurements were made for x-ray film. These films were investigated without amplification foils and with lead and salt foils. The radiation doses for x and γ rays went from 10 to 2560 mr, and the film darkening was measured up to D = 3. The sensitivity investigations were made for x-ray apparatus and for some radioisotopes. For each film type and each film-amplification foil combination, characteristic curves were plotted. The pattern of the characteristic curves showed that Foton dental x-ray film without amplifier foil was most suitable for x-radiation dose measurements and dosimetric Foton x-ray film with 0.25 × 0.25 mm lead foils for gamma radiation. The relative sensitivities, the amplification factors, and the effect of the radiation energy on the sensitivity of x-ray film and amplifier foils were tested. The results obtained are reported graphically. (tr-auth)

39682 FADING OF LATENT IMAGES IN POLISH-PRODUCED DOSIMETRIC FILM EMULSIONS. T. Musialowicz and J. Wysopolski (Central Laboratory for Radiological Protection, Warsaw). Symp. Tech. Zagadnien Ochrony Promieniowaniem, Warsaw, 172-8(1962). (In Polish)

The results of studies of the time effects on the fading of the latent image in dosimetric film emulsions that had been exposed to various doses of γ radiation from ^{226}Ra are reported and discussed. The film used was fabricated by the Warsaw Potochemical Installation under the name "Foton." The films were stored for time periods up to a year at an air temperature of 18 to 20°C and a humidity of 50 to 80%. On the basis of the results obtained it was established that a decrease of the film blackening as a result of fading of the latent image during one year is no greater than 10% (in relation to the darkening after 24 hrs), which in the reading of a γ dose corresponds to an error smaller than 20% (at S = 0.5 to 1.5). It was established that the fading of the latent image occurred principally in the first period after irradiation. (tr-auth)

39683 APPLICATION OF SEMICONDUCTOR DETECTORS IN DOSIMETRY. J. Roman, J. Chwaszozewska, and A. Kuchcinski (Inst. of Nuclear Research, Warsaw). Symp. Tech. Zagadnien Ochrony Promieniowaniem, Warsaw, 669-81(1962). (In Polish)

The construction of transistor detectors with large effective surface (up to 450 mm^2) of the n-silicon type with surface barriers is described. Detector mosaics were used. The progress made in the development of spectrometry for the detection of α contaminations with low activity levels and in the development of particle counters for use in radiation monitoring are described. (tr-auth)

39684 ENERGY DEPENDENCE OF DOSE SENSITIVITY OF GEIGER-MUELLER COUNTER TUBES AND SCINTILLATION COUNTERS FOR X AND GAMMA RAYS. K. H. Weber (VEB Vakutronik, Dresden). Symp. Tech. Zagadnien Ochrony Promieniowaniem, Warsaw, 682-99(1962). (In German)

The dose sensitivity (number of pulses per x ray) was calculated for G-M tubes and scintillation counters for x and γ rays in dependence on the quantum energy, and compared with experimental results. In counter tubes the sensitivity-energy curve passed through a maximum and a minimum. The dose sensitivity, especially, in the low energy range, depended strongly on the atomic number of the wall material and the wall thickness. In scintillation counters the form of the energy dependence was determined principally by the thickness and type of scintillator, but also on the height of the discriminator wave. For both detectors practical precautions for reduction of the energy dependence are discussed. (tr-auth)

39685 ZnS–Ag SCINTILLATORS FOR USE IN MEASUREMENTS WITH LITTLE SELF-ABSORPTION. A. Kostyrko, A. Wisniewski, and K. Zarnowiecki (Inst. of Nuclear

Research, Warsaw). Symp. Tech. Zagadnien Ochrony Promieniowaniem, Warsaw, 700-6(1962). (In Russian)

The effective operation of measurement systems for the detection of α particles depends on the quality of the scintillators to be used. Such scintillators must be characterized by a counting yield as high as possible; by a maximum value and an optimum spectrum of the light pulse; by small light loss within the scintillator and a low zero-effect noise; and by a mechanical stability as high as possible. For the detection of α particles, ZnS(Ag) scintillators, coated on a support of organic material or common glass, are most often used. The method for the fabrication of scintillators with optimum properties is reported. (tr-auth)

39686 BETA-GAMMA DOUBLE CHAMBER FOR PERSONNEL MONITORING. D. Herrmann (Institut fur Angewandte Radioaktivitat, Leipzig). Symp. Tech. Zagadnien Ochrony Promieniowaniem, Warsaw, 707-13(1962). (In Polish)

A double ionization chamber in the form of a fountain pen, which consists of a thick-walled β-insensitive γ part and a β part provided with thin windows, was developed. The γ sensitivities of both parts for ^{60}Co radiation agreed with each other. The β dose can be determined by the difference of the voltage drop at the β or γ part of the chamber. The mean energy of the β radiation to be detected was over 0.1 Mev. The wave-length dependence for γ radiation of 0.2 to 2.5 Mev effective energy was $\pm 25\%$ and varied for both parts of the chamber by a maximum of 15% with ^{60}Co γ radiation. (tr-auth)

39687 APPARATUS FOR MEASUREMENT OF MEDIUM-ENERGY GAMMA RADIATION FOR DOSIMETRIC PURPOSES. Sh. Deme and I. Erdel'vari (Central Inst. for Physics Research, Budapest). Symp. Tech. Zagadnien Ochrony Promieniowaniem, Warsaw, 714-29(1962). (In Russian)

Often in dosimetric measurements it is desirable to make a rapid identification of the radioisotope or a mean energy determination of the γ radiation arising from components of unknown energy (as in work with radioactive wastes or in the operation of accelerators). A battery-operated portable instrument was developed for the measurement of the γ radiation energy and a semi-automatic installation (with line feed) for absorption measurements of soft γ radiation. (tr-auth)

39688 RADIOACTIVE CONTAMINATION. [Yu. Volkov and I. Tkachuk.] Tekhn. i Vooruzhenie, No. 6, 78-9(1964).

The design of a warning device that automatically reports on radioactive contamination is described. Dry elements are used as power supply sources for the gas counter and all the relays. Either the network voltage or some other a-c source is used for ringing. (TCO)

39689 RANGE-ENERGY RELATIONS FOR HEAVY CHARGED PARTICLES IN GASES USING THE DOUBLE-GRIDDED IONIZING CHAMBER. D. E. Watt, J. Williamson, and J. H. Martin (United Kingdom Atomic Energy Authority, Chapelcross, Annan, Scotland, U. K.). p. 57-70 of "Biological Effects of Neutron and Proton Irradiations. Vol. I." Vienna, International Atomic Energy Agency, 1964.

The application of the double-gridded pulse ionization chamber to measuring the range-energy relations for alpha particles, protons, and heavy recoils is discussed. Range-energy values for recoil protons and alpha particles in a gas mixture of Argon plus 10% Methane are presented to confirm the method. The chamber described has been designed primarily for the measurement of proton ranges in a tissue-equivalent gas mixture of CO_2, CH_4, and N, and for fast neutron spectroscopy. (auth)

39690 STSINTILLYATSIONNYI METOD SPEKTROMETRII GAMMA-IZLUCHENIYA I BUSTRYKH NEITRONOV. (Scintillation Spectrometry of Gamma Emissions and Fast Neutrons). Yu. A. Egorov. Moscow, Gosatomizdat, 1963. 309p.

A review is given of the main problems in scintillation γ and fast neutron spectrometry. The principles of scintillation methods, parameters describing the performance of scintillation counters, various types of scintillation spectrometers, and spectral measurements in mixed gamma and neutron fields are considered. (R.V.J.)

39691 STSINTILLYATSIONNYE METODY REGISTRATSII CHASTITS BOL'SHIKH ENERGII. (Scintillation Methods for Registration of High-Energy Particles). Yu. K. Akimov. Moscow, Publishing House of Moscow State University, 1963. 171p.

A systematic survey is given of methods of recording high-energy particles using scintillation units. Basic characteristics of scintillation counters are reviewed, with special attention to pulse amplitude and time fluctuations. Properties of apparatus for registering pulse coincidence and anticoincidence are analyzed. Methods for identifying charged particles in accelerators according to various characteristics—direction of motion, path length in material, momentum, velocity, energy, ionization products, and lifetime—are surveyed, using concrete examples. Detectors constructed from assemblies of scintillating layers or threads are described. Questions relating to the method of registering neutrons and gamma quanta and to scintillation-counter use in hodoscope systems are considered. The book is written for the reader acquainted with the basics of scintillation-counter action and construction of electronic apparatus. (M.J.T.)

39692 TRACK SPARK CHAMBER FOR OBSERVATION OF HIGH ENERGY NUCLEAR INTERACTIONS. G. E. Chikovani, V. A. Mikhailov, and V. N. Roinishvili (Inst. of Physics, Academy of Sciences, Georgian SSR). p.517-29 of "International Conference on Cosmic Rays. Vol. 5." Bombay, Tata Inst. of Fundamental Research, 1964.

When operated on the so-called track regime, a spark chamber gives an exact space reproduction of tracks of particles moving at arbitrary angles with respect to the electric field. In such a chamber the development of streamers is artificially broken at an early stage and the track of a particle is observed as luminous columns situated on the trajectory of the particle. The experimental device used to study properties of the track chamber consists of a glass box filled with neon. The duration of the high-voltage pulse applied to the electrode grid is regulated by a shunting gap. An electronic circuit allows changes in the delay time between the passage of a particle and the triggering of the pulse. It was found that the number of luminous columns increases very slowly with the increase of delay time. The width of the columns at small delays fluctuated very slightly. Figures show the root mean square deviation of the luminous columns from the real trajectory, the results of calculation of avalanche fluctuations created by different numbers of primary electrons, and results of calculations of appearance of streamers with time. The track chamber gives tracks about one meter long and registers both single particles and large groups of particles. (A.G.W.)

39693 A STUDY OF CHARACTERISTICS OF SPARK CHAMBERS. V. N. Bolotov, M. I. Dayon, M. I. Devishev, L. F. Klimanova, B. I. Luchkov, and A. P. Shmeleva. p.534-9 of "International Conference on Cosmic Rays. Vol. 5." Bombay, Tata Inst. of Fundamental Research 1964.

The accuracy of a spark following along the particle trajectory in a gas spark chamber with a large gap was calculated. A systematic shift of the spark relative to the particle trajectory was observed, but systematic turning of the spark was absent. The probability of recording a separate charged particle when a large number of particles passes through a spark chamber was determined by recording in three spark chambers electron showers generated in a Pb target by particles of cosmic radiation. A spark chamber was also designed in which one of the electrodes of each gap was isolated from the operating gas by a layer of dielectric. Data on the efficiency of each gap at different delays of a high-voltage pulse indicate that chambers with dielectric have a large memory, good accuracy of the trajectory localization, and high efficiency of particle registration. (A.G.W.)

39694 TWO-ELECTRODE SPARK CHAMBER WITH LARGE DISCHARGE GAP IN A MAGNETIC FIELD AND THE MOMENTUM MEASUREMENT OF CHARGED PARTICLES. A. I. Alikhanyan, T. L. Asatiani, V. M. Krishtchyan, E. M. Matevosyan, and R. O. Sharkhatunyan (Inst. of Physics, Erevan). p.540-7 of "International Conference on Cosmic Rays. Vol. 5." Bombay, Tata Inst. of Fundamental Research, 1964.

Investigations carried out in the Soviet Union on two-electrode spark chambers with discharge gaps of 15 to 40 cm are reviewed. An attempt to measure momentum of charged particles in a chamber with a 40-cm gap gave good results for the mean value of the momentum but high straggling for individual cases. It is concluded that this type chamber is promising for the following reasons: good geometry; possibility of extension of track length to reasonable sizes; absence of any kind of distortions of the trajectories associated with simultaneous application of electric and magnetic fields; and the required small amplitude of the supplying pulse at sufficiently large other dimensions. (A.G.W.)

39695 SPARK-EMULSION CHAMBER FOR BALLOON FLIGHTS. K. Pinkau, U. Pollvogt, and C. Reppin (Universitat, Kiel). p.548-51 of "International Conference on Cosmic Rays. Vol. 5." Bombay, Tata Inst. of Fundamental Research, 1964.

A spark-emulsion chamber designed for cosmic radiation studies is described. It consists of an emulsion stack, a counter tray, a spark chamber, scintillators, and lead-emulsion sandwiches. It is intended to record nuclear interactions of charged and neutral particles in the stack, electromagnetic cascades, and nuclear interactions of charged particles in the lead. Results of a first test flight in Oct. 1963 are not yet available. (A.G.W.)

39696 LIMITATIONS TO THE USUAL METHOD EMPLOYED TO DETERMINE THE ENERGY OF ELECTROMAGNETIC CASCADES IN DENSE STACKS. K. Pinkau (Universitat, Kiel). p.555-8 of "International Conference on Cosmic Rays. Vol. 5." Bombay, Tata Inst. of Fundamental Research, 1964.

The usual method of determining the energy of electromagnetic cascades in dense stacks is to count the number of electrons $N(<R)$ within a defined radius R of the cascade axis, and to derive a value of the product $E_0 \times R$ corresponding to $N(<R)$ from a set of curves, which are unique to cascades of all energies. The method is valid only under an approximation called the core approximation where R is small. It is shown that the core approximation can not be valid beyond $R = 3 \times 10^{-3}$ radiation lengths. For energy determination of cascades using the core approximation two possibilities are given. One is to use stacks of smaller density (larger radiation length) for the high-energy cascades. The other is to restrict oneself to smaller physical regions of measurement in dense stacks, using thin layers of emulsions. (A.G.W.)

39697 CONSTRUCTION AND PERFORMANCE OF LARGE-AREA LIQUID SCINTILLATION COUNTERS AND LARGE-AREA MULTI-WIRE SPARK CHAMBERS. J. W. Koen, M. A. Meyer, and N. S. Wolmarans (Potchefstroom Univ. for C.H.E., South Africa). p.590-2 of "International Conference on Cosmic Rays. Vol. 5." Bombay, Tata Inst. of Fundamental Research, 1964.

Liquid scintillation counters and multiwire spark chambers having areas of about 35×100 cm^2 and larger were developed for a 30-ton solid iron magnetic momentum spectrograph. In the liquid scintillator, medicinal paraffin containing 80 g/l naphthalene and 3 g/l PPO was used. Light from the scintillator was absorbed by converters of medicinal paraffin containing 0.02 g/l POPOP, wavelength shifted, and emitted isotropically. The spark chamber through which argon was circulated consisted of two units screwed together. A polished Al plate electrode was cemented to one unit. The second unit consisted of a printed circuit board to which were attached 400 strips of Cu foil. A total of 400 enameled Cu wires was soldered to each strip. The distance between the multiwire electrode and the Al electrode was 6mm. (A.G.W.)

39698 LINEAR AMPLIFIER SYSTEM – 11X1980 (Engineering Materials). (California. Univ., Berkeley. Lawrence Radiation Lab.). (CAPE-1036)

Drawings (343) are presented for equipment known as the 198 system. The system has a variety of uses. The system contains a pulse-shaping amplifier, crossover timing unit, single channel analyzer, fast coincidence, linear gate and slow coincidence, biased amplifier and pulse stretcher, subtractor and expander amplifier, noise generator, pulse generator, ramp pulse generator, tail pulse generator, delay amplifier, delay lines, and a rate meter. The system occupies seven in. of space in a standard rack 19 in. wide. For a listing of individual titles, see the Engineering Materials List (TID-4100). (C.E.S.)

39699 DECADE SCALER WITH POSITIVE H-V POWER SUPPLY (Q-2188) (Engineering Materials). (Oak Ridge National Lab., Tenn.). (CAPE-1088)

Drawings (10) are presented for a scaler that is equipped with a power supply ranging from 600 to 1800 v, an electronic scale of 1,000, and a four digit mechanical register. It includes a signal pentode plate-loaded preamplifier with a single gain of about 30. The scaler may be used with either organic or halogen quenched Geiger counters or any counter that has a fairly large input signal such as an alpha scintillation counter. For a listing of individual titles, see the Engineering Materials List (TID-4100). (C.E.S.)

39700 INSTRUMENTS ASSOCIATED WITH FAST LOGIC FOR THE HIGH VOLTAGE LABORATORY, Q-2556 (Engineering Materials). (Oak Ridge National Lab., Tenn.). (CAPE-1094)

Drawings (11) are presented for equipment which is used with particle accelerators in the high voltage laboratory.

The equipment consists of fast coincidence circuit for a pair spectrometer, PP-1 and NP-1 slow coincidence anti-coincidence circuits, fast coincidence circuit, inspector amplifier, M-2 inspector amplifier and discriminator, inspector unit (MP), DG-2 variable delay unit, digital discriminator 256-8 bits, 4-parameter time pickoff and inspection system, and a pulse generator (Avalanche Transistor) circuit. For a listing of individual titles, see the Engineering Materials List (TID-4100). (C.E.S.)

39701 LASL ELECTRONICS COMPONENTS, GROUP 2 (Engineering Materials). (Los Alamos Scientific Lab., N. Mex.). (CAPE-1111)

Drawings (17) are presented for a group of electronic components that include amplifiers, preamplifiers, power supply pulsers, coincidence systems, rate meter, proportional hand counter, delay unit, and a mounting for a photomultiplier tube. For a listing of individual titles, see the Engineering Materials List (TID-4100). (C.E.S.)

39702 HOMOGENEITY SCANNER (Engineering Materials). (Oak Ridge National Lab., Tenn.). (CAPE-1136)

Fifty-eight drawings are included. The scanner is used in high speed homogeneity evaluation of fuel rods or plates. It employs industrial x-ray equipment as the radiation source and a combined NaI(Tl) crystal-photomultiplier tube as the radiation detector. The equipment employs the x or γ ray attenuation principle. The scanner longitudinal drive is provided by a 200 v $(3-\phi)$ motor that is equipped with a Graham transmission coupled to a $1\frac{1}{2}$ in. dia five-pitch lead screw. Maximum travel is 56 in. with continuous variable speed from 0 to 150 in. per min. Transverse drive is provided by a bifilar-wound Slo-Syn motor driving a $\frac{1}{2}$ in. dia ten-pitch lead screw. A motor on each end of the transverse mechanism provides drive pulses. Maximum transverse travel is 5 in. with continuously variable speeds of from 0 in. to 16 in. per min. A scaler, with associated circuitry, provides a means for automatic transverse indexing in increments of 0.0005 to 5 in. Fuel rods up to 50 in. long can be inspected and step rotated in increments of 1.8° or helically scanned with any desired pitch. (P.C.H.)

39703 SINGLE CHANNEL ANALYZER (Engineering Materials). (Los Alamos Scientific Lab., N. Mex.). (CAPE-1079)

Four drawings are included that show the schematics of the analyzer, gate generator, printer relay chassis and delay, and the gating circuits. A Model 61 power supply is used to provide regulated B+ bias and filament power for heavy chassis loads. The delay and gating uses a Model 51 power supply to provide regulated B+ bias and filament power for ordinary chassis loads. (P.C.H.)

39704 MONITORING FOR NOBLE RADIOACTIVE GASES WITH PHOTOGRAPHIC FILM. G. Hoyt Whipple and Donald E. Barber (Univ. of Michigan, Ann Arbor). 12p. (CONF-337-33)

From International Conference on Radioactive Pollution of Gaseous Media, Saclay, France, Nov. 1963.

The application of sensitive photographic film dosimeters to the environmental monitoring of noble radioactive gases at and below the public maximum permissible concentrations, and also at concentrations that might occur under accident conditions is described. It was concluded from both laboratory and field tests that sensitive personal monitoring film packets when dessicated and hermetically sealed, provide a reliable, convenient, and inexpensive means of monitoring for external radiation exposure, including that produced by noble gases, in the public areas surrounding nuclear plants. (P.C.H.)

39705 A NEW MONITOR OF AEROSOLS. D. Allenden. 10p. (CONF-337-31)

From International Conference on Radioactive Pollution of Gaseous Media, Saclay, France, Nov. 1963.

An instrument for monitoring airborne radioactive dust is described. The monitor meets the essential requirements of an air-monitoring instrument in that it assesses the true biological hazard regardless of its origin. The instrument is relatively portable and inexpensive, and employs unitized semiconductor circuitry throughout with no special components apart from the semiconductor detector. The very high sensitivity and speed of response, coupled with its high alpha resolution, suggests that it may have many other applications apart from its primary one of health monitoring. (P.C.H.)

39706 A SPARK CHAMBER SPECTROMETER FOR ENERGETIC PARTICLES IN SPACE. Richard Madey, Thomas Aggson, Robert Paige, and Peter Raft. 5p. (CONF-446-30)

From American Nuclear Society 10th Annual Meeting, Philadelphia, June 1964.

The design of a spark-chamber spectrometer whose purpose is the measurement of the proton energy spectrum between 10 and 300 Mev in space is described. (T.F.H.)

39707 FAST NEUTRON SPECTROMETER. Temple A. Love and Richard B. Murray (to U. S. Atomic Energy Commission). Canadian Patent 693,219. Aug. 25, 1964. Priority date Mar. 10, 1961, United States.

In this improved spectrometer, two adjacent radiation detectors each produce a signal and a neutron-sensitive means between the detectors produces a pair of particles whose total energy is uniquely related to the neutron captured. There is a means for adding together the signals produced by each coincident pair of particles. The output amplitude is proportional to the energy of the incident neutron. The instrument consists of silicon-gold surface-barrier detectors with Li^6F coating one of the opposed surfaces, counters, and analyzer. (F.S.A.)

39708 METHOD FOR MEASURING THE DOSE OF RADIOACTIVE RADIATION. Shvar Lotar. Russian Patent 161,816.

A method described for the measurement of radiation doses is distinguished by the fact that, in order to use various radiation detectors for measurement, the absorbed radiation dose is determined by the difference between two measurements with the aid of any type of radiation detector. The radiation is first recorded without an absorber, and then with an absorber (filter), the thickness and density of which vary either step-by-step or continuously. (A.T.D. Press)

ISOTOPE TECHNOLOGY

General

39709 (ORNL-TM-805) REACTOR PRODUCTION OF ^{109}Cd: ISOTOPIC COMPOSITION OF THE ^{109}Cd AND ITS USE AS AN X-RAY SOURCE. Howard T. Russell (Oak Ridge National Lab., Tenn.). Sept. 1964. Contract W-7405-eng-26. 10p.

Cadmium-109, with a 1.3-yr half life, was recovered from a reactor-irradiated silver target and used to demonstrate the feasibility of using a portable ^{109}Cd x-ray source for radiography. (auth)

39710 (RCC-R-176) A NEW METHOD FOR LEAK-TESTING SEALED SOURCES OF RADIUM-226 AND THORIUM-228. D. J. Dwight (United Kingdom Atomic Energy Authority. Research Group. Radiochemical Centre, Amersham, Bucks, England). July 1964. 25p.

A method has been developed in which radon leaking from radium-226 and thorium-228 sources under vacuum is quantitatively measured. The collection of radon is carried out by dissolution in an organic solvent. Measurement is carried out by liquid scintillation counting, using an internal phosphor. α and β particles are counted with high efficiency. The practical limits of leak detection are radon-222, 2×10^{-6} μC per 24 hours; and radon-220, 2×10^{-5} μC per 24 hours. (auth)

39711 ISOTOPES AND RADIATION TECHNOLOGY. Volume 1, Number 4. P. S. Baker, Robert H. Lafferty, Jr., Martha Gerrard, and D. A. Fuccillo, eds, (Oak Ridge National Lab., Tenn.). Summer 1964. $0.55(GPO) (domestic), $0.70(GPO) (foreign). (One of the Technical Progress Reviews prepared quarterly for the Division of Technical Information, USAEC). 71p.

A review of developments in radioisotopes and radiation technology is presented. Coverage includes isotope production and development, isotope technology development, isotope applications technology, process radiation development, and radiation processing of food and medical supplies. Separate abstracts are presented for seven papers. (N.W.R.)

For abstracts of individual topics see: 39765, 39766, 39767, 39768, 39769, 40934, and 40935.

39712 COMITÉ CONSULTATIF POUR LES ÉTALONS DE MESURE DES RADIATIONS IONISANTES, 4^{e} SESSION–1963 (6-7 MAI). (Fourth Session of the Consultative Committee for Standards of Measurement of Ionizing Radiations, May 6-7, 1963). Paris, Gauthier-Villars and Cie, 1963. 91p.

The minutes of the fourth session are presented, together with seven appendices on the reports of the study groups, the results of international comparisons of the radioisotopes ^{32}P, ^{131}I, ^{204}Tl, ^{198}Au, and ^{60}Co, and the definition of dimensions. Separate abstracts were prepared. (J.S.R.)

For abstracts of individual papers see: 39713, 39714, 39715, 39716, 39717, and 40081.

39713 RESULTS OF COMPARISON OF PHOSPHORUS-32. p.29-34 of "Standards of Measurement of Ionizing Radiations." Paris, Gauthier-Villars and Cie, 1963. (In French)

Sixteen laboratories participated in the comparison of the ^{32}P distributed by the Laboratoire de Mesure des Radioéléments of the Saclay Centre d'Études Nucléaires. The methods of preparation of the sources used by the various Laboratories are indicated, and the results are tabulated. The results are grouped at ±3% of the mean value 10.75 ± 0.1 μC/g, but thirteen laboratories obtained a result ±1% of the mean value. (J.S.R.)

39714 REPORT ON THE INTERNATIONAL COMPARISON OF IODINE-131. A. P. Baerg (National Research Council, Ottawa). p.35-46 of "Standards of Measurement of Ionizing Radiations." Paris, Gauthier-Villars and Cie, 1963. (In French)

Nineteen laboratories participated in the comparison of ^{131}I. The preparation and distribution of the samples were reported. The results obtained by sixteen laboratories were tabulated and graphed, together with errors, corrections, and remarks on the techniques used. (J.S.R.)

39715 REPORT ON THE INTERNATIONAL COMPARISON OF GOLD-198. P. J. Campion (National Physical Lab., Teddington, Eng.). p.47-52 of "Standards of Measurement of Ionizing Radiations." Paris, Gauthier-Villars and Cie, 1963. (In French)

Sources of ^{198}Au were distributed to 25 laboratories in aqueous solution sealed in glass ampules. The results of the comparison are tabulated and graphed. (J.S.R.)

39716 REPORT ON THE INTERNATIONAL COMPARISON OF COBALT-60. A. E. Kotchine (Inst. of Metrology, Leningrad). p.53-8 of "Standards of Measurement of Ionizing Radiations." Paris, Gauthier-Villars and Cie, 1963. (In French)

Samples of ^{60}Co were sent to 26 laboratories in the form of $CoCl_2$ in 0.1N HCl solution in sealed glass ampules. The results obtained by 21 laboratories and the methods used are tabulated. A mean value of 4.699 μC/g was obtained. (J.S.R.)

39717 REPORT ON THE INTERNATIONAL COMPARISON OF THALLIUM-204. J. C. Roy and L. Cavallo. p.59-82 of "Standards of Measurement of Ionizing Radiations." Paris, Gauthier-Villars and Cie, 1963. (In French)

Samples of ^{204}Tl were sent to 21 laboratories for analysis. A critical and detailed examination of the results reported by 19 laboratories is summarized. Analyses show that the variations in activity can be largely explained by the error introduced by applying the self absorption correction and to a lesser degree by errors introduced in applying the corrections for beta absorption in the support and efficiency of detection of radiations caused by electron capture. (auth)

Industrial Applications

Refer also to abstract 40033.

39718 (CONF-646-1) AN EVALUATION OF RADIOISOTOPE AND FLUORESCENT TRACER TECHNIQUES. Paul E. James and Dale E. Wilkins (Department of Agriculture, Beltsville, Md.). [1964]. 18p.

From American Society of Agricultural Engineers 1964 Annual Meeting, Fort Collins, Colo., June 1964.

A description is given of the research being done on the use of radioactive and fluorescent tracers to follow the removal and burial of contaminated surface soil. The equipment for conducting the tests and the methods used

are described. The advantages and costs of each of the methods are compared. (D.L.C.)

39719 (RT/GEO(64)-10) L'IMPIEGO DEI RADIOISOTOPI NELLA GEOTECNICA E NELLA MISURA DELL'INTERRIMENTO DI LAGHI. (The Use of Radioisotopes for Geotechnic and Lake Inearthing Measurements). E. Pirastru (Italy. Comitato Nazionale per l'Energia Nucleare, Rome). May 1964. 24p.

The advantages offered by the nuclear method for measuring soil density and moisture and lake inearthing are pointed out, in comparison with the usual laboratory methods. An outline of the atomic physics on which these measurements are based, is given. The different models of radioactive probes employed in geotechnics are illustrated, both for surface and depth measurements, by gamma ray back-scattering or absorption, and neutron slow-down. The methods for measuring muddy streams and water reservoir inearthing are examined; and it is observed that sediments dry density searched for can be obtained subtracting volumetric moisture (g/cm^3), measured by neutron slow-down probe, from wet density, measured by gamma ray back-scattering probe. (auth)

39720 (AEC-tr-6390) PROCEEDINGS OF THE TASHKENT CONFERENCE ON THE PEACEFUL USES OF ATOMIC ENERGY. VOLUME II. Translation of "Trudy Tashkentskoi Konferentsii po Mirnomu Ispol'zovaniyu Atomnoi Energii. Tom II" (a publication of the Publishing House of the Academy of Sciences, Uzbek SSR, Tashkent, 1960). 608p.

Seventy-three papers presented at the Tashkent Conference on the Peaceful Uses of Atomic Energy on the use of radioisotopes and nuclear radiations in mechanics, geology, and chemistry are included. Abstracts were prepared for 67 papers. Six papers were previously abstracted in NSA and appeared as 15: 7554, 15: 8766, 15: 10906, 17: 8493, 17: 10570, and 17: 23798. (M.C.G.)

For abstracts of individual papers see: 39023, 39062, 39063, 39064, 39170, 39171, 39172, 39173, 39174, 39175, 39283, 39284, 39285, 39286, 39287, 39288, 39289, 39290, 39480, 39513, 39514, 39515, 39516, 39517, 39629, 39630, 39721, 39722, 39723, 39724, 39725, 39726, 39727, 39728, 39729, 39730, 39731, 39732, 39733, 39734, 39735, 39736, 39737, 39738, 39739, 39740, 39741, 39742, 39743, 39744, 39745, 39746, 39747, 39748, 39749, 39750, 39751, 39752, 39753, 39754, 39755, 39756, 39757, 39758, 39780, 39781, and 39782.

39721 (AEC-tr-6390(p.1-3)) THE USE OF RADIOACTIVE ISOTOPES AND NUCLEAR RADIATIONS IN UZBEKISTAN. E. M. Lobanov. Translated from Tr. Tashkentsk. Konf. po Mirnomu Ispol'z. At. Energii, Akad. Nauk Uz. 2: 7-?(1960).

The industrial utilization of radioisotopes for flow detection, for control and automation of certain technological processes, in the silk and cotton industry, and in prospecting for minerals is discussed. (M.C.G.)

39722 (AEC-tr-6390(p.4-14)) PROBLEMS OF THE STANDARDIZATION OF TECHNOLOGICAL CONTROL APPARATUS BASED ON THE USE OF RADIOACTIVE ISOTOPES. I. M. Taksar and V. A. Yanushkovskiĭ. Translated from Tr. Tashkentsk. Konf. po Mirnomu Ispol'z. At. Energii, Akad. Nauk Uz. SSR, 2: 9-?(1960).

Instruments for positional control, relay action instruments, based on the use of radioisotopes are described. The relay methods of control are based on the registration of a sharp change in intensity of radioactive radiation, absorbed or scattered by the medium, independent of the particular specifics of the process of the controlled. Eight types of radioactive pickup instruments are discussed. Advantages of relay methods are outlined. (M.C.G.)

39723 (AEC-tr-6390(p.15-18)) MAGNETIC LIQUID FLOW METER. A. I. Zhernovoĭ and G. D. Latȳshev. Translated from Tr. Tashkentsk. Konf. po Mirnomu Ispol'z. At. Energii, Akad. Nauk Uz. SSR, 2: 17-?(1960).

A flow meter, based on nuclear resonance and suitable for the determination of the flow of liquids containing large amounts of hydrogen, fluorine, lithium, or other nuclei with a large gyromagnetic ratio, is described. The setup requires the presence of a portion of pipeline made out of nonmagnetic and electrically nonconducting material. The dependence of the amplitude of the nuclear magnetic resonance signal on the flow in a pickup with a flowing polarized liquid is utilized for the flow measurement. (M.C.G.)

39724 (AEC-tr-6390(p.19-21)) THE USE OF NUCLEAR MAGNETIC RESONANCE FOR DETERMINING THE ACTUAL VOLUME OF A STREAM OF LIQUID ON A PORTION OF PIPE WITH VARIABLE CROSS SECTION. A. I. Zhernovoĭ and G. D. Latȳshev. Translated from Tr. Tashkentsk. Konf. po Mirnomu Ispol'z. At. Energii, Akad. Nauk Uz. SSR, 2: 20-?(1960).

The change in magnetic moment of a polarized liquid during its passage through a certain volume was investigated for control in the creation of uniform distribution of the water velocity along the cross section in the expansion of pipeline. (M.C.G.)

39725 (AEC-tr-6390(p.22-6)) ON THE MEASUREMENT OF THE INSTANTANEOUS VALUES OF THE FLOW OF MATERIALS TRANSPORTED PNEUMATICALLY OR HYDRAULICALLY. M. Yu. Borukhov and V. N. Ivashev. Translated from Tr. Tashkentsk. Konf. po Mirnomu Ispol'z. At. Energii, Akad. Nauk Uz. SSR, 2: 22-?(1960).

Methods of measuring the average instantaneous values of the density and velocity of the materials transported through a set pipe cross section in order to determine the instantaneous values of flow are discussed. Density can be measured by absorption or scattering. Equations for determining velocity and flow are presented. (M.C.G.)

39726 (AEC-tr-6390(p.57-65)) PRINCIPLE OF AUTOMATION OF THE TWO-STAGE CYCLE OF THE PULVERIZATION AND CLASSIFICATION OF ORES. M. Yu. Borukhov, A. T. Lebedev, and U. Akbarov. Translated from Tr. Tashkentsk. Konf. po Mirnomu Ispol'z. At. Energii, Akad. Nauk Uz. SSR, 2: 25-?(1960).

The use of radiation in automating the two-stage cycle for pulverization and classification of ores is discussed. Two independent regulation units are used. The first maintains optimum loading of the mill with ore in the presence of varying qualitites of ore sent for grinding, thus protecting the mill from obstruction with ore. The second maintains a set value of the pulp density on the outlet from the second classification stage. (M.C.G.)

39727 (AEC-tr-6390(p.32-6)) UNIFIED RADIOACTIVE ISODROMIC REGULATOR (URIR). M. Yu. Borukhov and A. T. Lebedev. Translated from Tr. Tashkentsk. Konf. po Mirnomu Ispol'z. At. Energii, Akad. Nauk Uz. SSR, 2: 29-?(1960).

A unified radioactive isodromic regulator (URIR) was developed for the automation of technological processes

controlled by means of radioactive radiations. The equipment includes a gamma source, remote-control data unit, electronic unit, and stabilizer to supply the electronic circuits with stabilized voltage. (M.C.G.)

39728 (AEC-tr-6390(p.51-6)) DETERMINATION OF THE WEAR OF AUTOMOBILE TIRES USING THE ISOTOPE Tl^{204}. A. Snisarenko, Z. Tarasova, E. Nepomnyashchiĭ, and V. Novopol'skiĭ. Translated from Tr. Tashkentsk. Konf. po Mirnomu Ispol'z. At. Energii, Akad. Nauk Uz. SSR, 2: 43-?(1960).

A method for determining the wear of tire tread under road test conditions was developed, based on the registration of the change during the process of wear in the intensity of the penetrating beta radiation from point sources situated under the surface of the tread. Use of ^{204}Tl made it possible to determine the wear of rubber in the range 0 to 1.3 mm with a sufficient degree of accuracy (±0.01). Point sources of ^{204}Tl were introduced into the tread in a direction parallel to the surface of the running path or at a small angle to it using a medical syringe needle. This method made possible a 10-fold reduction of the distance of the run needed to determine the durability of a tire under road test conditions. (M.C.G.)

39729 (AEC-tr-6390(p.57-65)) EXPERIENCE IN THE USE OF SCINTILLATION GAMMA FLAW DETECTION. A. A. Arkhangel'skiĭ and G. D. Latyshev. Translated from Tr. Tashkentsk. Konf. po Mirnomu Ispol'z. At. Energii, Akad. Nauk Uz. SSR, 2: 47-?(1960).

Some characteristics of photomultipliers and their use in scintillation gamma flaw detection are discussed. The sensitivity of the flaw detector and experiments in detection of flaws are described. The experiments confirmed the advantages of scintillation gamma flaw detection and its suitability for mass testing. (M.C.G.)

39730 (AEC-tr-6390(p.66-74)) GAMMA RADIOGRAPHY OF REINFORCED CONCRETE. R. V. Levitskiĭ, A. M. Gurevich, D. F. Pavlov, and M. Doolotbekov. Translated from Tr. Tashkentsk. Konf. po Mirnomu Ispol'z. At. Energii, Akad. Nauk Uz. SSR, 2: 53-?(1960).

Gamma radiography of blocks of reinforced concrete by radioscopy of the block with gamma rays and the formation of exposed places on an x-ray film placed behind the block is described. The density of the blackening of the film after development corresponds to the internal structure of the block. Methods were developed for determining exposure time. (M.C.G.)

39731 (AEC-tr-6390(p.75-87)) GAMMA RADIOGRAPHY OF PARTS OF RAILROAD ROLLING STOCK. I. I. Yakobson. Translated from Tr. Tashkentsk. Konf. po Mirnomu Ispol'z. At. Energii, Akad. Nauk Uz. SSR, 2: 59-?(1960).

A procedure for gamma radioscopy, using ^{60}Co, of important parts of railway transport rolling stock was developed. The physical principles, geometrical conditions, and selection of optimum focal length for gamma radiography are discussed. The exposure, method of screening, photographic processing of the films, and analysis of gamma–gams are described. The limits of applicability were determined. (M.C.G.)

39732 (AEC-tr-6390(p.88-90)) GAMMA RADIOGRAPHY OF WELDED SEAMS OF CIRCULATION PIPES. L. B. Chubarov. Translated from Tr. Tashkentsk. Konf. po Mirnomu Ispol'z. At. Energii, Akad. Nauk Uz. SSR, 2: 69-?(1960).

A procedure for the gamma radioscopy of welded seams of circulation pipes was developed using the isotopes ^{60}Co and ^{137}Cs. Sensitivity was evaluated according to the least depth of grooving of the standard visible on the gamma photograph in examinations through a specially prepared negatoscope. A densitometry procedure permits rapid and simple analysis of the dimensions of the flaws. (M.C.G.)

39733 (AEC-tr-6390(p.91-4)) ON THE POSSIBILITY OF USING RADIOACTIVE COBALT FOR THE QUALITY CONTROL OF THE LAYING OF BRICK WALLS. M. M. Muminov. Translated from Tr. Tashkentsk. Konf. po Mirnomu Ispol'z. At. Energii, Akad. Nauk Uz. SSR, 2: 71-?(1960).

The possibility of using gamma radiation from ^{60}Co to check on the quality of brick laying was investigated. The gamma source and counter are set up on the same level on opposite sides of the wall to be investigated. The intensity ratio for gamma transmission through the seam and through the brick was determined. (M.C.G.)

39734 (AEC-tr-6390(p.95-107)) THE USE OF RADIOACTIVE ISOTOPES IN THE COTTON INDUSTRY. A. D. Grober. Translated from Tr. Tashkentsk. Konf. po Mirnomu Ispol'z. At. Energii, Akad. Nauk Uz. SSR, 2: 73-?(1960).

The use of radioisotopes in the cotton industry for control of processes in the treatment of cotton is discussed. The absorption of gamma radiation of various energies by cotton materials was studied. A contactless radioactive gage of the weight of fiber in the tamping box of the press was investigated. Radioactive feed regulators were planned for use in the operation of fuzz separators and cleaners. Radioactive signalers of clogging were also developed. The use of tracers to study the rates of various processes was also investigated. (M.C.G.)

39735 (AEC-tr-6390(p.108-13)) RADIOACTIVE METHODS OF EVALUATING THE OPERATING QUALITIES OF MOTOR OILS AND MACHINES. R. A. Srapenyants. Translated from Tr. Tashkentsk. Konf. po Mirnomu Ispol'z. At. Energii, Akad. Nauk Uz. SSR, 2: 84-?(1960).

The use of radioisotopes and radiation in testing and investigating motor lubricants and machines used in agriculture is discussed. A method for direct determination of the moment of loss of mobility of a piston ring using radiation is proposed. Short-term engine methods of evaluating the tendency of lubricating oils to cause clogging of piston ring with coke were developed. The variation of the basic operating qualities of working diesel oils was investigated using radioactive methods. A field radiometric laboratory was developed for determining wear and mobility of diesel tractor piston rings. (M.C.G.)

39736 (AEC-tr-6390(p.114-16)) ATTENUATION OF GAMMA RAYS BY WOOL AND COTTON. N. Badalov and M. Muninov. Translated from Tr. Tashkentsk. Konf. po Mirnomu Ispol'z. At. Energii, Akad. Nauk Uz. SSR, 2: 88-?(1960).

The linear coefficient of absorption of gamma rays for various thicknesses and densities of cotton and wool was determined so that gamma radiation could be used in density measurements of cotton or wool. Data were obtained using a ^{60}Co gamma source and plotted. (M.C.G.)

39737 (AEC-tr-6390(p.117-29)) CALCULATION OF A RADIOCHEMICAL SETUP WITH A POWERFUL SOURCE OF GAMMA RADIATION FOR THE OXIDATION OF BENZENE TO PHENOL. B. I. Vaĭnshteĭn, A. Kh. Breger, and N. P. Sÿrkus. Translated from Tr.

Tashkentsk. Konf. po Mirnomu Ispol'z. At. Energii, Akad. Nauk Uz. SSR, 2: 90-?(1960).

A theoretical calculation was made for two variations of apparatus for radiochemical oxidation of benzene to phenol. The output and efficiency of piping and a tubular heat exchanger with irradiators of ^{60}Co and of the heat-producing sections of the VVR-Ts reactor were calculated. It was found that when G = 30 and the gamma efficiency $\eta = 0.8$, the specific output of the apparatus consists of 0.8 gram/hr per watt of gamma power achievable. An estimate showed that the maximum output of phenol in a setup using a reactor can be 10,000 tons/yr at G = 60 molecules/100 ev. (M.C.G.)

39738 (AEC-tr-6390(p.130-8)) UNIVERSAL SETUP WITH A Co^{60} GAMMA RADIATION SOURCE WITH ACTIVITY 60,000 GRAM RADIUM EQUIVALENTS FOR MODEL STUDIES OF RADIOCHEMICAL APPARATUS AND FOR CONDUCTING INVESTIGATIONS (K-60,000). A. Kh. Breger, V. B. Osipov, and V. A. Gol'din. Translated from Tr. Tashkentsk. Konf. po Mirnomu Ispol'z. At. Energii, Akad. Nauk Uz. SSR, 2: 100-?(1960).

Apparatus with ^{60}Co gamma source was designed that permits model studies of radiochemical instruments under practically any physico-chemical conditions. The activity of the irradiator could be varied from 3,000 to 60,000 gram radium equivalents. The method of assembling the gamma source and the operating principle of the setup are described. (M.C.G.)

39739 (AEC-tr-6390(p.139-55)) SCIENTIFIC AND TECHNICAL BASES FOR THE DEVELOPMENT OF RADIOCHEMICAL APPARATUSES. A. Kh. Breger. Translated from Tr. Tashkentsk. Konf. po Mirnomu Ispol'z. At. Energii, Akad. Nauk Uz. SSR, 2: 107-?(1960).

Problems in the development of radiochemical apparatuses are discussed. The primary problem was considered the development of apparatuses and methods for the industrial realization of highly efficient radiochemical processes utilizing high-energy gamma sources in heterogeneous systems. The most promising of the radiation sources for industrial radiochemical setups were found to be fuel elements of nuclear reactors. Basic requirements for radiochemical apparatuses are listed. (M.C.G.)

39740 (AEC-tr-6390(p.156-9)) SETUPS OF THE ACADEMY OF SCIENCES UZBEK SSR FOR VARIOUS GAMMA RADIATION INVESTIGATIONS AND SEMIINDUSTRIAL EXPERIMENTS. U. A. Arifov, S. V. Starodubtsev, E. M. Lobanov, G. A. Klein, and S. Z. Pashinskii. Translated from Tr. Tashkentsk. Konf. po Mirnomu Ispol'z. At. Energii, Akad. Nauk Uz. SSR, 2: 120-?(1960).

Work was begun on the design and preparation of gamma installations using ^{60}Co as irradiation sources. A high-power water-protected gamma installation was designed for receiving gamma sources up to an activity of 6×10^5 curies at a rapid rate. (M.C.G.)

39741 (AEC-tr-6390(p.160-72)) ABSORPTION OF GAMMA RADIATION IN MACROSYSTEMS. A. Kh. Breger, B. I. Vaĭnshteĭn, L. S. Guzeĭ, Yu. S. Ryabukhin, and N. P. Sȳrukus. Translated from Tr. Tashkentsk. Konf. po Mirnomu Ispol'z. At. Energii, Akad. Nauk Uz. SSR, 2: 123-?(1960).

A method was developed for determining the gamma energy absorbed by objects of various volumes and sizes during irradiation in the field of gamma sources of various configurations. The absorbed gamma energy was determined as the difference between the total gamma energy flux of the source and the gamma energy flux coming from the surface of the irradiated objects. Concepts of efficiency of the absorbing medium with respect to gamma radiation and of buildup factor of the integral flux were introduced. (M.C.G.)

39742 (AEC-tr-6390(p.173-92)) ORGANIZATION OF LABORATORIES FOR WORK USING RADIOACTIVE SUBSTANCES. N. I. Leshchinskiĭ, G. N. Lokhanin, and A. S. Shtan'. Translated from Tr. Tashkentsk. Konf. po Mirnomu Ispol'z. At. Energii, Akad. Nauk Uz. SSR, 2: 132-?(1960).

General principles of organizing work with radioactive substances are reviewed. Use of radioactive substances in closed form and open form, equipment of laboratory rooms, protective equipment for work with radioactive substances, instruments, protective adaptations, transport facilities, sanitary-hygienic equipment, furniture and implements, individual protective devices, collection and removal of radioactive wastes, and training of personnel are discussed. (M.C.G.)

39743 (AEC-tr-6390(p.193-201)) DEVELOPMENT OF A TRANSPORTABLE GAMMA SETUP FOR IRRADIATION OF SEEDS BEFORE PLANTING. A. V. Bibergal, N. I. Leshchinskiĭ, M. M. Korotkov, and O. G. Arakelov. Translated from Tr. Tashkentsk. Konf. po Mirnomu Ispol'z. At. Energii, Akad. Nauk Uz. SSR, 2: 148-?(1960).

A gamma irradiator was designed for use in the irradiation of seed before planting. ^{137}Cs was used as the source in order to develop a transportable setup. The dose field was calculated by two different methods. (M.C.G.)

39744 (AEC-tr-6390(p.202-13)) EXPERIMENTAL SEMIINDUSTRIAL GAMMA SETUP FOR RADIATION TREATMENT OF THE AGRICULTURAL PRODUCTS OF GEORGIA. I. D. Artmeladze, A. V. Bibergal, and T. V. Tsetskhaldze. Translated from Tr. Tashkentsk. Konf. po Mirnomu Ispol'z. At. Energii, Akad. Nauk Uz. SSR, 2: 155-?(1960).

Investigations are being made of facilities and methods for radioinduced extermination of mulberry silkworm cocoons, radioinduced acceleration of the aging of wines and brandies, and the radiosterilization of perishable products, fruit preserves, and juices. An irradiation facility employing gamma sources was designed for an initial value of the integral dose of 300,000 r at an output of 80 kg/hr for objects with a density of 1 g/cm^3 and with a uniform dose field within limits of ±10%. (M.C.G.)

39745 (AEC-tr-6390(p.214-22)) SOME PROBLEMS OF THE CALCULATION AND PLANNING OF HIGH-POWER GAMMA UNITS. A. V. Bibergal, N. I. Leshchinskiĭ, U. Ya. Margulis, and V. G. Khrushchev. Translated from Tr. Tashkentsk. Konf. po Mirnomu Ispol'z. At. Energii, Akad. Nauk Uz. SSR, 2: 164-?(1960).

The design and operation of gamma irradiators are discussed. Methods of calculating the dose field of the gamma units are presented. (M.C.G.)

39746 (AEC-tr-6390(p.223-38)) INDUSTRIAL GAMMA UNIT FOR THE STERILIZATION OF MEDICAL MATERIALS. V. G. Khrushchev, A. S. Lepilin, U. Ya. Margulis, S. M. Stepanov, L. I. Belen'kiĭ, T. V. Bromberg, and V. G. Ivliev. Translated from Tr. Tashkentsk. Konf. po Mirnomu Ispol'z. At. Energii, Akad. Nauk Uz. SSR, 2: 170-?(1960).

The development of a gamma irradiator for the radioinduced sterilization of medical materials is described. The dose needed for sterilizing bandaging materials, 1.8×10^6 r, was experimentally determined. A facility was designed for cold sterilization using ^{60}Co with an output of three tons per day. Irradiation of boxes of the medical

supplies in two cycles with automatic changing of place of the boxes was used. The coefficient of useful utilization of radiation equaled 49%. (M.C.G.)

39747 (AEC-tr-6390(p.239-51)) GAMMA UNIT FOR CONTINUOUS IRRADIATION OF POTATOES. V. G. Khrushchev, B. A. Rubin, L. V. Metlitskiĭ, A. I. Rytov, N. M. Gaĭsin, U. Ya. Margulis, V. S. Grammatikati, G. V. Vlasov, and A. V. Petrov. Translated from Tr. Tashkentsk. Konf. po Mirnomu Ispol'z. At. Energii, Akad. Nauk Uz. SSR, 2: 182-?(1960).

Investigations of the gamma irradiation of potatoes to prevent sprouting were made. Processes that occur in the potato under gamma irradiation and the optimum doses necessary to restrain sprouting were determined. The design of an irradiation facility for this purpose is described. (M.C.G.)

39748 (AEC-tr-6390(p.252-61)) ECONOMIC EFFECTIVENESS OF THE UTILIZATION OF HIGH-POWER GAMMA UNITS IN LIGHT INDUSTRY AND THE FOOD INDUSTRY. N. S. Prokof'ev. Translated from Tr. Tashkentsk. Konf. po Mirnomu Ispol'z. At. Energii, Akad. Nauk Uz. SSR, 2: 192-?(1960).

Results of investigations of the economics of the use of gamma radiation in the light and food industry are discussed. Topics covered include: extermination and preservation of cocoons, disinfestation of grain, radio-induced sterilization and pasteurization of food, and retarding sprouting of potato tubers during storage. (M.C.G.)

39749 (AEC-tr-6390(p.262-6)) THE USE OF A MULTICHANNEL SCINTILLATION GAMMA SPECTROMETER FOR THE ANALYSIS OF ROCK SAMPLES. A. A. Abdullavev, E. M. Lobanov, A. P. Novikov, and A. A. Khaĭdarov. Translated from Tr. Tashkentsk. Konf. po Mirnomu Ispol'z. At. Energii, Akad. Nauk Uz. SSR, 2: 199-?(1960).

One of the variations of the use of a multichannel scintillation spectrometer for the analysis of rock samples and the qualitative and semiquantitative determination of minerals in wells using radioactive core sampling is described. The gamma spectra of neutron-irradiated samples are registered on a scintillation gamma spectrometer and then analyzed. By measuring the changes in the intensity of the entire spectrum with time, multicomponent mixtures could be analyzed. (M.C.G.)

39750 (AEC-tr-6390(p.279-89)) INVESTIGATION OF THE TRANSMISSION OF GAMMA QUANTA THROUGH MATTER BY THE MONTE CARLO METHOD. A. F. Akkerman, P. L. Gusika, and D. K. Kaipov. Translated from Tr. Tashkentsk. Konf. po Mirnomu Ispol'z. At. Energii, Akad. Nauk Uz. SSR, 2: 212-?(1960).

The problem of the applicability of neutron diffusion theory to photon problems was solved on the basis of a comparison of the diffusion characteristics calculated according to diffusion theory and calculations according to the Monte Carlo method. The effectiveness of the method of selective gamma-gamma core sampling for various concentrations of a heavy element in a rock with a small average atomic number was determined. (M.C.G.)

39751 (AEC-tr-6390(p.339-41)) PORTABLE RADIOACTIVE DENSITY INDICATORS. E. M. Lobanov, N. S. Matveev, B. E. Krylov, and R. I. Gladysheva. Translated from Tr. Tashkentsk. Konf. po Mirnomu Ispol'z. At. Energii, Akad. Nauk Uz. SSR, 2: 254-?(1960).

Portable density indicators, suitable for controlling the filling of cylinders with compressed gas, detecting the sites of obstruction of pipelines, and a rough determination of the density of process media were developed. The indicators are based on the principle of absorption of gamma radiation by matter and operate according to a gamma relay circuit. Instrument diagrams are shown. (M.C.G.)

39752 (AEC-tr-6390(p.342-6)) X-RAY-STEREOSCOPIC SETUP. B. F. Pavlovskiĭ, B. S. Mazitov, and B. B. Akabirov. Translated from Tr. Tashkentsk. Konf. po Mirnomu Ispol'z. At. Energii, Akad. Nauk Uz. SSR, 2: 258-?(1960).

Apparatus permitting stereoscopic observation of parts with x rays was designed. The eclipse method is used for the observation of stereo-pairs. Its advantages are the realization of three-dimensionality, the possibility of detecting fine details, and the relative simplicity of this method. The equipment consists of a control panel, generator device, stand with protective casing, x-ray tubes, oil pump, and stereoscopic box. The x rays from two tubes alternately pass through the investigated detail. The projection on the x-ray screen is reflected from a mirror and directed to the eye of the observer. (M.C.G.)

39753 (AEC-tr-6390(p.347-51)) GAMMA RAY LEVEL GAUGES FOR GROAT-MILLING AND COMBINED FEED ENTERPRISES. E. S. Pertsovskiĭ and N. D. Lerman. Translated from Tr. Tashkentsk. Konf. po Mirnomu Ispol'z. At. Energii, Akad. Nauk Uz. SSR, 2: 262-?(1960).

Gamma level indicators for combined feed plants and groat-milling enterprises are described. They provide 3 or 4 channels with a common feed unit. They can be placed on the inner surface of the walls, and their time of operation does not exceed 4 or 5 sec. (M.C.G.)

39754 (AEC-tr-6390(p.352-4)) POSSIBLE METHOD OF CONTINUOUS REMOTE CONTROL OF THE LEVEL OF SILT IN SILT BASINS BY MEANS OF A GAMMA RELAY CIRCUIT. I. G. Abramson and L. Z. Nemenman. Translated from Tr. Tashkentsk. Konf. po Mirnomu Ispol'z. At. Energii, Akad. Nauk Uz. SSR, 2: 266-?(1960).

The use of gamma relay circuits in cement plants for continuous and remote control of the level of silt in silt basins is discussed. Two metallic tubes, set up over the entire height of the basin, are introduced into the basin. Both tubes are connected from below by another tube. Therefore the liquid in the tubes is at the same level. Each of the tubes has a floating device. One of them contains a gamma source and the other a data unit of a two-position relay. A hydraulic device moves the source and data units to coincide with silt level as indicated by the relays. (M.C.G.)

39755 (AEC-tr-6390(p.378-86)) ON THE RESULTS OF THE FIRST INDUSTRIAL TESTS OF A WELL NEUTRON GENERATOR. B. G. Erozolimskiĭ, D. F. Bespalov, L. N. Bondarenko, L. R. Voĭtsik, N. V. Popov, A. I. Khaustov, Yu. S. Shimelevich, A. S. Shkol'nikov, and L. I. Yudin. Translated from Tr. Tashkentsk. Konf. po Mirnomu Ispol'z. At. Energii, Akad. Nauk Uz. SSR, 2: 285-?(1960).

Uses of radiometric methods in the petroleum industry are discussed. Tests were made of a pulsed neutron method for activation analysis of oil-bearing and water-bearing strata. The neutron generator used consisted of a small-size accelerator tube, a high-voltage unit, units for controlling the systems of operation of the tube, and a unit of BF_3 proportional counters. The working parameters of the well instrument are controlled and regulated from the surface of the ground. (M.C.G.)

39756 (AEC-tr-6390(p.397-402)) USE OF THE METHOD OF NEUTRON ACTIVATION ANALYSIS FOR INVESTIGATING SCALE DEPOSITS AND DETERMINING THE WEAR OF TRACTOR ENGINE PARTS. R. A. Srapenyants and B. B. Nefedov. Translated from Tr. Tashkentsk. Konf. po Mirnomu Ispol'z. At. Energii, Akad. Nauk Uz. SSR, 2: 299-?(1960).

A method of neutron activation analysis of scale deposits formed on engine parts was developed. The participation of diesel fuel in the formation of deposits in the zone of the piston rings of the tractor engine was established. Neutron activation analysis was also used to determine the wear of the cylinder case-piston ring coupling. (M.C.G.)

39757 (AEC-tr-6390(p.403-18)) USE OF RADIOACTIVE RADIATIONS FOR THE RAPID DETERMINATION OF THE WEIGHT AND MOISTURE CONTENT OF PEAT UNDER FIELD CONDITIONS. B. Ya. Minkov and N. V. Churaev. Translated from Tr. Tashkentsk. Konf. po Mirnomu Ispol'z. At. Energii, Akad. Nauk Uz. SSR, 2: 303-?(1960).

The use of radioisotope to determine the bulk weight, thickness, and moisture content of peat by gamma radioscopy is discussed. For use in the field an apparatus called a radiofork was developed. It consists of two Duralumin tubes with a ^{60}Co gamma source in one and a counter in the other. (M.C.G.)

39758 (AEC-tr-6390(p.545-52)) THE PRODUCTION OF COMPOUNDS WITH A DOUBLE LABEL. V. V. Bochkarev, E. A. Tikhomirova, and V. P. Shishkov. Translated from Tr. Tashkentsk. Konf. po Mirnomu Ispol'z. At. Energii, Akad. Nauk Uz. SSR, 2: 410-?(1960).

The preparation of compounds with two or more radioisotopes incorporated in them is discussed. The use of a mixture of two (or more) preparations consisting of the same compounds, but labeled by different isotopes to produce the double label is described. Methods of measuring emitted beta and gamma radiation are considered. (M.C.G.)

39759 A SIMPLE RADIOGRAPHIC METHOD FOR DACTYLOSCOPIC STUDIES. A. Ya Gel'fman, G. L. Granovskii, and L. Ya. Kheifets. At. Energ. (USSR), 17: 71(July 1964). (In Russian)

A method for deciphering invisible or obscure perspiration-soaked fingerprints is described. The investigated object is placed in an aqueous solution of formaldehyde, tagged with ^{14}C, and is then photographed using contact radiography. (M.J.T.)

39760 SURVEY ON THE USE OF RADIOISOTOPES IN BRITISH INDUSTRY AND INDUSTRIAL RESEARCH. D. F. O. Stuart and F. Birch. Atom, No. 94, 176-90(Aug. 1964).

The use of radioisotopes in British industry in gages, gamma radiography, ionization, bulk and cell irradiation, and as tracers for analysis and studies of factory process is discussed, along with economics and growth of isotope techniques. (P.C.H.)

39761 NUCLEAR TECHNOLOGY SERVES EUROPEAN AGRICULTURE. Euratom Bull., 3: No. 3, 3-9 (Sept. 1964).

The organization of Euratom/ITAL, a partnership between the European Atomic Energy Community and the Instituut voor Toepassing van Atoomenergie de Landbouw, for research by Euratom in the agricultural field is described; and the Euratom/ITAL program is presented. The Institute's research program aims at the production of more and better food and its rational and economic storage by: using radiation to induce suitable genetic changes in plants, thus adapting them to modern requirements; using new nuclear techniques or new developments of them for learning more about the physiological mechanisms of plants and about the environmental factors which affect their growth and reproduction; and extending the storage life of fresh or preserved foods by the use of radiation. (H.M.G.)

39762 FOOD IRRADIATION—AN IMPROVEMENT TO HUMAN DIET. D. de Zeeuw (Euratom ITAL Assn.). Euratom Bull., 3: No. 3, 15-17(Sept. 1964).

Research carried out in the past twenty years to evaluate irradiation as a tool for food preservation is summarized. Attention is given studies of: sprout inhibition in potatoes and onions, extension of shelf life of fresh fruit and vegetables, insect control in cereals and flour products, and improvement of dairy products. (H.M.G.)

39763 IRRADIATED MUSHROOMS TASTE BETTER. Oscar L. Staden (Institute for Research on Storage and Processing of Horticultural Produce, Wageningen, Netherlands). Euratom Bull., 3: No. 3, 18-19(Sept. 1964).

Results of a screening program initiated in 1962 by the Institute for Research on Storage and Processing of Horticultural Produce and the Euratom/ITAL Association for the investigation of possibilities offered by irradiation for lengthening shelf life of fruit and vegetables are reviewed. Although radiopreservation is not feasible with all fruits and vegetables, results were encouraging in a large number of those tried, especially in mushrooms, which are apparently improved by the process. (H.M.G.)

39764 ELECTRONICS WATCH CIGARETTE FILLING. P. J. Robins. Ind. Electron., 135-7(Mar. 1964).

To handle a high-priced commodity like tobacco, electronic weighing, analysis and direct control of machines were developed to hold the quantity used as a filler to within ±1% of a calculated figure. The automatic machine can be fitted with control equipment that scans continuously the density of tobacco in each cigarette, gives meter indication, expresses digitally the percentage of cigarettes in each of five weight zones, records automatically the percentage of cigarettes in the correct weight sector, and gives pen-recorder traces that enable faulty parts of the machine to be pinpointed with precision. (P.C.H.)

39765 TRACERS IN ANALYSIS. Isotopes Radiation Technol., 1: No. 4, 293-306(Summer 1964).

Recent applications of radioactive tracers to analytical chemistry and new developments in counting equipment and techniques are reviewed. Radiometric analytical methods used in controlling the quality of cement are summarized. The determination of fluoride by an extraction procedure using tantalum-182, of sulfate with chromium-151, and of several metals by amalgam-exchange separation is reviewed. (N.W.R.)

39766 MARINE PRODUCTS DEVELOPMENT IRRADIATOR. Philip Miller and R. J. Herbert (Associated Nucleonics, Inc., Garden City, N. Y.). Isotopes Radiation Technol., 1: No. 4, 310-17(Summer 1964).

A description of the Marine Products Development Irradiator used for preservation of seafood products includes the design of the building, the cobalt-60 gamma source, and the conveyor system for continuous irradiation of seafood products. The processing procedure is discussed. The design changes needed for a commercial unit and the econom-

ics of the radiopasteurization process are evaluated. (N.W.R.)

39767 RADIATION PRESERVATION OF NEW ENGLAND SEAFOODS. Joseph W. Slavin, Maynard A. Steinberg, and Louis J. Ronsivalli (Bureau of Commercial Fisheries Technological Lab., Gloucester, Mass.). Isotopes Radiation Technol., 1: No. 4, 317-22(Summer 1964).

The effect of gamma radiation on the palatability and general acceptability of a number of raw and blanched seafoods is investigated. With respect to nutritional value, a comparison of the free and total amino acids and B vitamin contents of irradiated samples of soft-shell clams with those in commercially processed samples showed no great differences. Mass spectrometry is being used to identify more of the many compounds that make up the flavor and odor of these products. Several compounds are identified in clam meats from known retention times in gas-chromatography columns. Organoleptic studies on irradiated samples of soft-shell clam meats and fillets of haddock, ocean perch, and pollock indicate that, when supplemented with storage at 33°F, this technique will triple the product shelf life without adverse changes in flavor and odor. In general, these products can be irradiated at levels less than 500,000 rads and stored for 30 days at 33°F. Storage at 42°F results in about a 50% decrease in the shelf life of the irradiated seafood. The quality of the raw material significantly influences the shelf life and acceptability of the irradiated product. Fish stored longer than 7 to 9 days in ice should not be irradiated because of the limited shelf life of the product. (N.W.R.)

39768 PRODUCTION AND MEDICAL USES OF ^{67}Ga, ^{68}Ga, AND ^{72}Ga. J. J. Pinajian (Oak Ridge National Lab., Tenn.). Isotopes Radiation Technol., 1: No. 4, 340-3 (Summer 1964).

The possible usefulness of radioactive gallium in bone tumor detection and treatment is evaluated. The preparation of gallium isotopes is outlined. (N.W.R.)

39769 CLINICAL USES OF ^{125}I. Isotopes Radiation Technol., 1: No. 4, 343-4(Summer 1964).

The medical uses of iodine-125 are reviewed along with physical and chemical aspects. (N.W.R.)

39770 RADIATION PRESERVATION OF MEATS AND SEAFOODS. R. F. Cain and A. F. Anglemier (Oregon State Univ., Corvallis). J. Animal Sci., 23: 572-6(May 1964).

The research program being conducted in the Department of Food Science and Technology at Oregon State University relating to preserving foods by ionizing radiations is discussed and the findings since 1954 are reviewed. The feasibility of beef radiosterilization and studies on the influence of radiosterilization on some of the muscle characteristics involved in meat texture are discussed. It is concluded that irradiation causes fragmentation of beef muscle proteins. The fragmentary alterations of the proteins, the incorporation of water within the fragments, plus a slight liberation of the bound electrolytes, to give a possible slight salting-in effect of the proteins, appear to be the major factors accounting for the irradiation effects on meat texture. (TCO)

39771 DETERMINATION OF THE OPTIMUM STERILIZING DOSAGE FOR PINK BOLLWORMS TREATED AS PUPAE WITH GAMMA RADIATION. Milton T. Ouye, Ruben S. Garcia, and Dial E. Martin (Dept. of Agriculture, Brownsville, Tex.). J. Econ. Entomol., 57: 387-90(June 1964).

Successful results obtained using irradiated sterile males to eradicate the screw-worm from the Southeastern United States prompted this investigation during 1961-62 of the effect of γ radiation on the pink bollworm Pectinophora gossypiella, also a polygamous insect. Pupae were irradiated with a ^{60}Co source at dose rates of 560 R/min. Pupal sensitivity to radiation was dependent on age at time of treatment: the older the pupae, the less susceptible they were. When one- and three-day-old pupae were irradiated, doses inducing complete sterility also caused some pupal mortality and appreciable moth damage; however, irradiation of 5- or 7-day-old pupae induced almost complete sterility without pupal mortality or adult malformation. When males from irradiated 7-day-old pupae were mated with untreated females, complete sterility was achieved at 55 kR, and within the range of 30 to 60 kR, no more than 3% of the oviposited eggs hatched at any one exposure dosage. Exposure at 40 kR was sufficient to sterilize females. Longevity of males from 7-day-old pupae treated with 35 through 90 kR was significantly shorter than that of the control. The reduced longevity of sterile males demonstrated here may not be a disadvantage in applying the sterile-male technique, since earlier studies of mating habits of the pink bollworm showed that most of the matings of untreated moths occur well within the period covered by the shortened lifespan of the sterile males. Thus the sterile males may be equally competitive with nonsterile males for the normal female. (BBB)

39772 RADIOMETRIC DENSITY GAUGING IN A STEAM TURBINE. H. Loeffler (Institut für Anwendung Radioaktiver Isotope, Aussenstelle Pirna-Copitz, [Ger.]). Kernenergie, 7: 550-4(June-July 1964).

A method of radiometric determination of the steam density distribution in a steam turbine based on the transirradiation of wet steam is described. The steam is irradiated by beta particles inciding perpendicularly to the steam-flow direction. A density gage, at a constant source-to-detector distance, rotates radially in the turbine. The mean density at any point is calculated from the observed values after taking into account the mass absorption coefficient. The principle, construction, calibration, operation, performance, and applications of the technique are described and some results are presented. The radiometric measurements verified that the steam density at the blade tips and in the clearance between the rotor and turbine cylinder is higher than in the region of the shaft. (M.C.G.)

39773 THE DIMENSIONING OF RELAY-CONTROLLED SERVOMECHANISMS FOR RADIOMETRIC LEVEL INDICATION. K. Irmer (Institut für Anwendung Radioaktiver Isotope, Aussenstelle Pirna-Copitz, [Ger.]). Kernenergie 7: 554-7(June-July 1964). (In German)

Optimum dimensions for follower-type radiometric level gages were established for various types of application. Optimization was accomplished by taking into account the filling rate, the experimental error, the characteristics of the gage, and the required degree of accuracy. Radiometric level gages are considered of special value when liquids of explosive, highly viscous, or chemically corrosive nature are involved. The methods of calculating optimum dimensions are discussed and the effects of radioactive decay in the source are described. (OTS)

39774 RADIATION STERILIZATION OF MEDICAL SUPPLIES. S. Jefferson, F. J. Ley, and F. Rogers (Atomic Energy Research Establishment, Wantage, Berks, Eng.). Nucl. Eng., 9: 284-6(Aug. 1964).

A facility for routine gamma-irradiation sterilization of

medical supplies is described. Regulatory guidelines for future facilities of this type are discussed. (T.F.H.)

39775 CHANGES IN THE BLACK SHANK DISEASE REACTION OF SUSCEPTIBLE TOBACCO (NICOTIANA TABACUM) INDUCED BY GAMMA IRRADIATION. J. L. Apple (North Carolina State Coll., Raleigh). Phytopathology, 54: 23-8(Jan. 1964).

Seeds of five flue-cured tobacco (Nicotiana tabacum) varities were exposed to gamma irradiation (^{60}Co) levels of 20, 30, 40, and 50 kR. Since comparatively little irradiation damage was evident at the lower levels, only progeny from the 50 kR populations were screened for resistance to the black shank disease (caused by Phytophthora parasitica var. nicotianae). Approximately 701,800 G_2 seedlings were screened as individual plant progenies of G_1 plants. No G_2 plants of the three highly susceptible varieties survived (402, Virginia Gold, and Virginia 21), but 30 plants from the two varieties with some initial tolerance (Bottom Special and Hicks) were grown to maturity. Progeny from two of these plants (both from Bottom Special) yielded two distinct mutants with a moderate level of black shank resistance. One was shorter than the control, but similar in morphology; whereas the other was taller with conspicuous puckering of the leaf lamina. Both mutant types produced an undesirable pleiotropic effect on cured leaf quality compared with the control. Resistance was partially dominant when the mutants were crossed to the control parent and the undesirable pleiotropic effect was partially lost. It is postulated that the resistant character involved in these two mutants is dominant with a penetrance value of 70 to 80% in the homozygote and 40 to 50% in the heterozygote. (auth)

39776 RADIATSIONNYI KONTROL' I IZMERENIE IZDELII. (Radiation Control and Measuring of Industrial Goods). E. B. Milevskii. Moscow, State Scientific-Technical Machinery Literature, 1963. 132p.

Radioactive decay, units of measurement, selection of isotopes, and basic processes of radiation reactions with matter are discussed. Methods for measuring radiation, methods for absorption of radiation, and methods for radiation backscatter are considered. Control of the diameter of cylinders and control of the thickness of cylinder walls are also discussed. (C.E.S.)

39777 INDUSTRIAL USES OF RADIATION. G. Cahen and P. Treille. p.417-32 of "Precis d'Energie Nucleaire." Paris, Dunod, 1963. (In French)

Discussion is given on the production of radioisotopes by particle accelerators, extraction from fission products, and neutron irradiation. The use of radioisotopes as the sources of ionizing radiation and their biological effects, which make them useful for induced mutation of plants, destruction of insects and other pests in grain, sterilization and pasteurization of foodstuffs are discussed. β-Emitters (^{90}Sr, ^{32}P, ^{131}I, etc.) are useful for medical purposes such as the treatment of cancer. The chemical effects of nuclear radiations are used for initiating polymerization, modifying the quality of plastics, and chemical synthesis. Other uses include the elimination of static, production of electricity, and detection of smoke for fire alarms, thickness measurement, density determination, level gages, quantitative analysis, radiography (especially gammagraphy) and autoradiography, tracers for labeling organic compounds, metals, wear and tear of metal parts in machines or of auto tires, for determining liquid flow, detecting leaks, studying weak solubilities, chemical kinetics, structure of molecules and crystals, studying water and air movement, studying fertilizers, the metabolism of organic substances in living organisms, and research on growth, assimilation, and photosynthesis. The constant production of heat, especially by α-emitters, is used for producing thermoelectricity in space vehicles. (OID)

39778 USE OF IONIZING RADIATION TO IMPROVE POLYMER-METAL LAMINATES. Herbert R. Anderson Jr. (to Phillips Petroleum Co.). U. S. Patent 3,146,146. Aug. 25, 1964. Filed July 11, 1961.

A method is given for increasing the strength of the bond of polymer-metal laminates. The method simply comprises placing a solid polymer in pressure contact with the metal, heating the polymer to above its crystalline melting point, and irradiating the molten polymer with gamma-ray doses of 10^5 to 10^{10} rep. Polymers which may be used include trans- and cis-polymers of conjugated dienes, polyethylenes of high crystallinity, polypropylene, and copolymers of ethylene with 1-olefins. The method is particularly useful in bonding Al and brass to polymers, or to themselves using an intermediate polymer layer. Examples of the method are given. (D.L.C.)

Separation and Production

Refer also to abstracts 39584 and 39777.

39779 (IFA-30-IS) THE OPTIMAL CONDITIONS OF SEPARATION IN A THERMAL DIFFUSION COLUMN WITH HOT WIRE. APPLICATION TO THE NITROGEN ISOTOPES. G. Vasaru (Academia R. P. R. Institutul de Fizica Atomica, Cluj). [195?]. 12p.

Jensen's equations are used to simplify the calculation of optimal conditions for isotope separation by thermal diffusion. Numerical calculations were carried out for $10 \leq R/r \leq 95$ and r = 0.015, 0.02, and 0.03 cm, where R = column radius and r = hot wire radius. The application of the results to separation of ^{14}N and ^{15}N is described, with the optimal parameters being determined from graphs of τ, l_0, and p_0 vs R and R/r. The deviation of the experimental results from the theory is discussed. (D.L.C.)

39780 (AEC-tr-6390(p.419-28)) PRODUCTION OF PURE RADIOACTIVE ISOTOPES WITHOUT CARRIERS. N. P. Rudenko. Translated from Tr. Tashkentsk. Konf. po Mirnomu Ispol'z. At. Energii, Akad. Nauk Uz. SSR, 2: 317-?(1960).

The preparation of radioisotopes without carriers by various nuclear reactions is discussed. The reactions considered include (n,γ), (n,p), (n,α), fission, and (t,p) reactions. Methods of isolation of the desired radioisotope described are extraction, chromatography, electrolysis and electrochemistry, adsorption and radiocolloid, and precipitation. (M.C.G.)

39781 (AEC-tr-6390(p.488-92)) PRODUCTION OF RADIOISOTOPES IN A REACTOR USING THRESHOLD, SUCCESSIVE AND SECONDARY NUCLEAR REACTIONS. V. I. Levin and V. V. Bochkarev. Translated from Tr. Tashkentsk. Konf. po Mirnomu Ispol'z. At. Energii, Akad. Nauk Uz. SSR, 2: 368-?(1960).

The production of radioisotopes in reactors by (N,γ), (N,α), (N,p), and (N,2N) threshold, successive, and secondary reactions is discussed. (M.C.G.)

39782 (AEC-tr-6390(p.533-9)) PRODUCTION OF ARSENIC-77 WITHOUT A CARRIER FROM NEUTRON-IRRADIATED GERMANIUM. M. M. Golutvina, V. I. Levin, and E. A. Tikhomirova. Translated from Tr. Tashkentsk.

Konf. po Mirnomu Ispol'z. At. Energii, Akad. Nauk Uz. SSR, 2: 402-?(1960).

^{77}As is formed when ^{76}Ge is irradiated by slow neutrons. ^{77}Ge and ^{77m}Ge produced in this reaction decay to ^{77}As. In order to obtain arsenic without a carrier, it can be separated from germanium by solvent extraction using HCl and CCl_4. (M.C.G.)

39783 ISOTOPE SEPARATION BY THE MOLECULAR BEAM CHOPPER METHOD. E. Bagge (Universität, Kiel). Atomkernenergie, 9: 241-52(July-Aug. 1964). (In German)

The process difference for isotope separation by a molecular beam chopper separation unit was calculated for very narrow and for finite openings of the inlet diaphragm. The resulting values for the separative powers for these units were compared with those of a diffusion unit for the cut $\frac{1}{2}$. The separative power for the molecular beam unit in the ideal case was higher by a factor 19 than that for the corresponding diffusion unit. Experimental results are reported for three different units. The Ag molecular beam unit reached the theoretical valve of the process factor, whereas one with two turbines coupled with the separation unit gave enrichments of ±3.5% for CO_2, or about $\frac{1}{10}$ of the value that can possibly be reached by better diaphragms. (auth)

39784 APPLICATION OF STABLE ISOTOPES IN RESEARCH AND TECHNOLOGY IN THE GERMAN DEMOCRATIC REPUBLIC. J. Muehlenpfordt (Institut für Stabile Isotope, Leipzig). Kernenergie, 7: 485-93(June-July 1964).

Stable isotopes are used in the German Democratic Republic for research and technological purposes chiefly in the fields of chemistry, biochemistry, physiology, pharmacology, and geology. Facilities and uses are discussed, with special emphasis on separation of stable isotopes, preparation of labeled elements and compounds, analysis of stable isotopes, and actual applications. (M.C.G.)

39785 THE PRODUCTION OF RADIOACTIVE SOURCES. R. Muenze, M. Bubner, and P. Knoll (Zentralinstitut für Kernforschung, Rossendorf, Ger.). Kernenergie, 7: 493-5 (June-July 1964). (In German)

The preparation of radioisotopes with the aid of the 2-Mw nuclear reactor and the 25-Mev cyclotron at the Central Institute for Nuclear Research since 1959 is described. Among the products manufactured are short-lived gamma-emitting substances, ^{32}P, ^{35}S, uranium fission products, carrier-free radionuclides, and labeled organic compounds. Tables indicating production volume since 1959 were presented. The output and manufacturing techniques used are surveyed and uses are discussed. (M.C.G.)

39786 SEALED RADIOACTIVE SOURCES — A SURVEY OF THEIR DEVELOPMENT AND MANUFACTURE IN THE GDR. G. Vormum (Institut für Angewandte Isotopenforschung der DadW, Berlin-Buch). Kernenergie, 7: 496-502 (June-July 1964). (In German)

Sealed radiation sources have been prepared in the German Democratic Republic since 1956. ^{239}Pu serves as the principal source for alpha radiation, ^{210}Po is less frequently used. The following radioisotopes are processes into sealed beta sources: ^{85}Kr, ^{90}Sr, ^{106}Ru, ^{147}Pm, and ^{204}Tl. One source of radiation is being manufactured from a gold–carbon target in conjunction with a backscattering and frontal target of lead. The sealed sources for gamma radiation include ^{60}Co, ^{192}Ir, ^{170}Tm, and ^{137}Cs. Methods for preparation, typical applications, production data, special sources, and current research projects are discussed. (OTS)

39787 REACTOR-PRODUCED CARRIER-FREE IRIDIUM-194. M. Peisach (Soreq Research Establishment, Nahal Soreq, Israel). Radiochim. Acta, 2: 197-201(July 1964). (IA-855)

Reactor irradiation of natural osmium leads to osmium-194 by second order neutron capture. When converted to osmium tetroxide, millicurie amounts of carrier-free iridium-194 can be recovered repeatedly from the decay of a single sample of osmium-194 by vacuum distillation. The half life of pure iridium-194 was found to be 17.4 ± 0.1 hours. (auth)

MATHEMATICS AND COMPUTERS

Refer also to abstract 39346.

39788 (AEEW-R-206) A STANDARD ANALOGUE COMPUTER METHOD FOR FREQUENCY RESPONSE ANALYSIS. M. N. John (United Kingdom Atomic Energy Authority. Reactor Group. Atomic Energy Establishment, Winfrith, Dorset, England). Oct. 1962. 12p.

A standard method developed for use of the PACE 231R analog computer to determine frequency response characteristics of analog models in a simple manner that eliminates uncertainty due to interpretation of the measurements is discussed. (auth)

39789 (ANL-6888) IPL-VC—A COMPUTER SYSTEM HAVING THE IPL-V INSTRUCTION SET. Donald Hodges (Argonne National Lab., Ill.). May 1964. Contract W-31-109-eng-38. 17p.

The conversion of CDC 3600 to an Information Processing Language–V system is described. The advantages of using the processor for specific problems are discussed. (R.E.U.)

39790 (EUR-1643.e(p.3-11)) STUDY AND EXECUTION OF ANALOG-DIGITAL COMPUTING AT EURATOM. A. Debroux, H. d'Hoop, and A. Riotte (European Atomic Energy Community. Joint Nuclear Research Center, Ispra, Italy).

Two types of linkage between analog and digital computers are considered: static linkage, which places the analog computer under the direct or indirect control of the digital computer in the problem set-up phase (the APACHE code and its technical and programming developments are described); and dynamic linkage, corresponding to a particular form of the hybrid concept suitable for big general purpose computing centers. Work and studies in these fields are described and a bibliography is given. (auth)

39791 (EUR-1643.e(p.13-28)) NUCLEAR CODES. G. Pozzi and C. Tamagnini (European Atomic Energy Community. Joint Nuclear Research Center, Ispra, Italy).

A description is given of the work carried out in the analysis and overall testing of the computer codes received; a table showing the relative utilization time of these codes is included. A description of the studies carried out at Ispra (Scientific Data Processing Center) with regard to the preparation of new codes is given. A list of Euratom reports, written at Ispra and describing these studies, is included. (auth)

39792 (EUR-1843.e) GLEE: GENERALIZED LIBRARY EDITOR AND EXECUTOR. J. S. Annino and L. A. Sangermano (Praxis Calcolo S.P.A., Milan). 1964. 26p.

The GLEE system was designed to permit nuclear codes as well as other often used programs to reside either on tape or magnetic disk, and to be accessible quickly by a standard calling procedure. Programs written in a variety of source languages can be added without modification, and a provision is made for monitor as well as on-line operation. An automatic blocking feature permits the rapid retrieval of card images in conjunction with program distribution. The system is now operating at CETIS. (auth)

39793 (IDO-16977(p.55-72)) APPLIED MATHEMATICS AND MACHINE COMPUTATIONS. (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho).

Substantial progress has been made in the writing of new 7040 programs and in the conversion of existing 7090 codes. The 650 Simulator is in operation and a number of programs have been put into service on it. (auth)

39794 (NAA-SR-Memo-9721) ISRCH, A BINARY SEARCH FORTRAN FUNCTION SUBPROGRAM. R. A. Blaine (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Mar. 25, 1964. Contract [AT(11-1)-Gen-8]. 7p.

A routine is described, which determines the index of the table entry that is the greatest lower bound to a given value. This routine uses the binary search technique and is written in FAP. For a table containing 1024 entries, the maximum execution time on an IBM 7094 is approximately 0.3 milliseconds. Two entry points are provided to allow for ascending or descending tables. (auth)

39795 (NASA-TN-D-2454) TABLES OF X-COEFFICIENTS AND A-FACTORS FOR TRIPLE ANGULAR CORRELATION ANALYSIS. Jag J. Singh and Chris Gross (National Aeronautics and Space Administration. Langley Research Center, Langley Station, Hampton, Va.). Sept. 1964. 69p.

The Fano X-functions X (abc,def,ghk) and the A_{ghk} angular functions used in analyses of triple correlation measurements in nuclear reaction studies are tabulated for a and d to 3; for b,c,e, and f at half-integrals or integral values to 5; and for g, h, and k at integral values to 8. The computer programs for extension of the tables are given. (R.E.U.)

39796 (NIRL/R/65) A USER'S GUIDE TO THE ORION FORTRAN MONITOR SYSTEM. D. A. Harragan (Gt. Brit. National Inst. for Research in Nuclear Science. Rutherford High Energy Lab., Chilton, Berks, England). Apr. 1964. 21p.

The function of FORMAP is to direct and control the compiling, editing, and assembling of source programs written in FORTRAN. The FORMAP system consists of four main parts: the MONITOR/EDITOR, a FORTRAN compiler (FORCOM), a FALAN compiler (FACOM), and an Assembler. Thus FORMAP was designed to provide the facilities such as are available in the IBM 7090 FORTRAN Monitor; there is, however, no automatic execution of the object program. More effective operation of job sequences is obtained by assembling a number of object programs on one magnetic tape during a monitor run. These programs can be subsequently loaded into core and executed in the time-sharing mode. Large jobs that have to be in chain form can be assembled on private tapes possibly as absolute binary object programs. The guide describes the Monitor operations, control directives, the various intermediate and final outputs, default action, the monitor job form, and instructions to operators. Examples are given of the input and printing for jobs processed by FORMAP. The method of loading and running execution jobs after assembly is included, particularly the make-up of job descriptions. The functions of the two compilers FORCOM and FACOM are briefly outlined here, but users should already have a good knowledge of FORTRAN programming and should consult the FORSOL papers if coding queries arise. The program languages involved are FORTRAN, FALAN, FAMAP, BIMAP, and BINARY. The last two are not strictly languages but refer to the form in

which the machine-coded program is output by the assembler. (auth)

39797 (NIRL/R/68) AN INDEX TO FORTRAN FACILITIES ON ORION. R. Taylor (Gt. Brit. National Inst. for Research in Nuclear Science. Rutherford High Energy Lab., Chilton, Berks, England). Apr. 1964. 6p.

A survey of FORTRAN features for the ORION computer is presented. (R.E.U.)

39798 (UCRL-7920) TABLES OF CALABRO KAPPA SQUARE STATISTIC. James L. Willows (California. Univ., Livermore. Lawrence Radiation Lab.). June 11, 1964. Contract W-7405-eng-48. 62p.

Tables are presented giving values of the K^2 statistic developed by S. R. Calabro in his book, "Reliability Principles and Practices." The K^2 values were calculated from the equation $K^2 = [(Z_\alpha - Z_\beta\sqrt{k})/(k-1)]^2$, where Z_α and Z_β are the normal deviates corresponding to the producer's risk and consumer's risk, respectively, and k = (lot tolerance fractional reliability deviation)/(acceptable reliability level). (D.L.C.)

39799 CHARACTERS OF IRREDUCIBLE REPRESENTATIONS OF THE SIMPLE GROUPS. I. GENERAL THEORY. J.-P. Antoine and D. Speiser (Université, Louvain, Belg.). J. Math. Phys. (N. Y.), 5: 1226-34(Sept. 1964).

New formulas for the characters of irreducible representations of simple groups are presented. They yield the character directly as a sum instead of a quotient as does Weyl's formula. The procedure is purely geometrical and is based on the properties of the regular lattice associated with every simple group in the global theory of Lie groups due to Hopf and Stiefel. (auth)

39800 SOLUTION OF MILNE'S EQUATION FOR GENERAL LINE PROFILES BY POWER SERIES EXPANSION. Folker Engelmann (Euratom-CNEN, Frascati, Italy). J. Quant. Spectr. Radiative Transfer, 4: 507-25 (July-Aug. 1964).

Milne's integral equation for a finite system and arbitrary line profile is transformed into an infinite system of linear equations by power series expansion. For some special situations of spherical symmetry this system is solved and the solution of Milne's equation is given explicitly. Thus good insight of the dependence of the solution of Milne's equation on the physical parameters is obtained. The method described seems useful also for numerical calculations. (auth)

39801 INTEGRALS INVOLVING PRODUCTS OF G-FUNCTION AND GAUSS'S HYPERGEOMETRIC FUNCTION. K. C. Sharma (Univ. of Rajasthan, Jaipur, India). Proc. Cambridge Phil. Soc., 60: 539-42(July 1964).

Two definite integrals involving the product of Meijer's G-function with Gauss's hypergeometric function are evaluated. (C.E.S.)

39802 INTEGRALS OF TRIPLE PRODUCTS OF ASSOCIATED LEGENDRE FUNCTIONS. E. L. Albasiny, R. J. Bell, and J. R. A. Cooper (National Physical Lab., Teddington, Middx, Eng.). Proc. Phys. Soc. (London), 84: 336-8(Aug. 1964).

The application of Gauss–Legendre quadrature to the evaluation of integrals of products of associated Legendre functions is discussed, with reference to a tabulation of those integrals most frequently encountered in theoretical physics and chemistry. (auth)

39803 SYMMETRY. AN INTRODUCTION TO GROUP THEORY AND ITS APPLICATIONS. R. McWeeny. A Pergamon Press Book. The International Encyclopedia of Physical Chemistry and Chemical Physics. Topic 1. Mathematical Techniques. Volume 3. New York, The Macmillan Company, 1963. 259p.

Topics in group theory are reviewed, including: basic properties of groups; lattices and vector spaces; point and space groups; representations of point and translation groups; and irreducible representations. Applications of the theory are presented, with primary attention to: the applications of quadratic forms to crystal properties and molecular vibrations; the symmetry properties of functions, as they are applied in the eigenvalue equation of quantum mechanics; and tensor properties and tensor operators. (T.F.H.)

39804 AN INTRODUCTION TO THE SECOND METHOD OF LYAPUNOV AND ITS APPLICATION TO THE ANALYSIS OF ENERGY CONVERSION PROCESSES. Gary L. Blank (Minneapolis-Honeywell Regulator Co., St. Petersburg, Fla.). 19p. (CONF-637-4)

From Institute of Electrical and Electronics Engineers Region 3 Annual Meeting and Technical Conference, Clearwater, Fla., May 1964.

The second method of Lyapunov for determining the stability of the solutions of systems of differential equations is applicable to any dynamic system (electrical, mechanical, chemical, nuclear) provided that the governing differential equations of the system can be written. It does not require solutions of the equations. The problem is reduced to finding certain functions of the state of the system. In this introduction to the method, concepts and definitions are established and illustrative examples are given. Advantages and disadvantages of the method are pointed out. (A.G.W.)

39805 A FAST DIRECT SOLUTION OF POISSON'S EQUATION USING FOURIER ANALYSIS. R. W. Hockney (Stanford Univ., N. J.). 39p. (CONF-471-38)

From American Physical Society 5th Annual Meeting, San Diego, Calif., Nov. 1963.

The demand for rapid procedures to solve Poisson's equation lead to the development of a direct method of solution involving Fourier analysis, which can solve Poisson's equation in a square region covered by a 48×48 mesh in 0.9 second on the IBM 7090. This compares favorably with the best iterative methods that would require about 10 seconds to solve the same problem. The method is applicable to rectangular regions with simple boundary conditions and the maximum observed error in the potential for several random charge distributions is 5×10^{-7} of the maximum potential change in the region. (auth)

METALS, CERAMICS, AND OTHER MATERIALS

General

39806 (ANL-6757) ATTEMPTED PREPARATION OF SINGLE CRYSTALS OF ALPHA PLUTONIUM. Progress Report. Alan F. Berndt (Argonne National Lab., Ill.). May 1964. Contract W-31-109-eng-38.

The standard methods of crystal growth are discussed in light of their applicability to the problem of growing single crystals of alpha plutonium. The results of some experiments designed to prepare single crystals of alpha plutonium are presented. These experiments include attempts at crystal growing by solid-state reactions, electrolytic reduction of plutonium halides, precipitation from a liquid metal in convection cells, and reduction of plutonium halides by lithium in nonaqueous solvents. The indexing of powder patterns and the determination of the unit cell of alpha plutonium were proved by an x-ray study of a small single crystal of a plutonium-neptunium alloy having the alpha-plutonium structure. (auth)

39807 (BM-RI-6362) CONTINUOUS ELECTROWINNING OF CERIUM METAL FROM CERIUM OXIDES. Edward S. Shedd, J. D. Marchant, and T. A. Henrie (Bureau of Mines. Reno Metallurgy Research Center, Nev.). Sept. 1963. 14p.

Cerium metal was electrowon in a fluoride bath from cerous oxide and tapped from the cell during prolonged operation. Electrolyte constituents were CeF_3, BaF_2, and LiF. Twenty-seven pounds of metal of 99.8 percent purity were produced at a rate of 3 pounds per hour and tapped from the cell. Principal impurities were molybdenum, aluminum, oxygen, and carbon. The operating parameters, such as electrode geometry, bath compositions, and oxide feed rate, were investigated. Anode reactions were found to be important factors in cell operation. Stable cerous oxide reacted more uniformly at the anode surface than ceric oxide. Electrowinning was conducted in crucible hearths consisting of both frozen electrolyte and molybdenum metal. Both materials proved satisfactory and did not react with the molten cerium. Stable cerous oxide was prepared by carbothermic reduction and used as a feed material. Cell design proved to be an important factor in continuous cell operation. Complementary to the investigations of electrowinning of cerium, the metal was purified by electrorefining in a chloride electrolyte. (auth)

39808 (BM-RI-6507) MOLTEN-SALT ELECTROREFINING OF URANIUM. F. R. Cattoir and T. A. Sullivan (Bureau of Mines. Boulder City Metallurgy Research Lab., Nev.). Feb. 1964. 28p.

Commercial uranium metal was electrorefined to a high-purity product using molten-salt electrolytes in an inert atmosphere cell. Electrorefined uranium that contained, after consolidation, less than 30 ppm of metallic impurities was prepared. A method of leaching the electrolyte crystals to remove the salts was developed. Cathode current efficiencies from 90 to 100 percent were obtained. Two molten-salt electrolytes were prepared and evaluated: (1) lithium chloride–potassium chloride–uranium trichloride and (2) sodium chloride–potassium chloride–uranium trichloride. Very little difference was found in the purity of the uranium metal produced in either system. The lithium chloride–potassium chloride–uranium tri-chloride electrolyte was preferable from an operational standpoint. (auth)

39809 (CALT-473-2) ETCHING OF HIGH-PURITY ALUMINUM. Technical Report No. 2. W. F. Greenman (California Inst. of Tech., Pasadena. W. M. Keck Lab. of Engineering Materials). Aug. 1964. Contract AT(04-3)-473. 12p.

An investigation has been made of dislocation etchants for pure aluminum for the purpose of finding a dislocation etchant for {111} surfaces that does not require decoration of dislocations by bulk diffusion. Chemical etchants previously reported have been studied, as well as surface doping with mercuric and ferric ions and ion bombardment in argon and neon. No etching technique was found to reveal fresh dislocation intersections on {111} planes, but the greatest possibility for success of future investigations would seem to be with surface doping. (auth)

39810 (DP-901) THERMAL FATIGUE TESTS. MATERIALS OF CONSTRUCTION FOR DENITRATOR POTS. Louis P. Costas (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). July 1964. Contract AT(07-2)-1. 24p.

Stainless steel denitrator pots at the Savannah River Plant have deformed and cracked by thermal fatigue. Subsequent examination of the microstructure of type 347 stainless steel used in these vessels revealed the presence of sigma phase and led to speculation that sigma phase may play a role in embrittling the steel. Thermal fatigue tests carried out on 304L, 316, and 347 stainless steels showed that of the three, type 347 was superior and that sigma phase was not a factor in failure. Tests made with copper, clad on both sides with stainless steel, indicated that the composite material would prevent thermal fatigue by eliminating the large temperature gradients that lead to deformation and subsequent failure. (auth)

39811 (EUR-1608.f) ESSAIS EXPLORATOIRES POUR L'UTILISATION DE GAINES TRES MINCES POUR CRAYON DE COMBUSTIBLE. (GAINES EN ACIER INOXYDABLE EN SOLLICITATION TRIAXIALE). (Exploratory Tests with a View to the Use of Extra-Thin Claddings for Fuel Pins. (Stainless-steel Claddings with Triaxial Loading)). L. Alfille (European Atomic Energy Community. Joint Nuclear Research Center, Ispra, Italy) and G. Valentin (Société d'Études Industrielles, Villejuif, France). 1964. 72p.

In the design of fuel elements with extra-thin cladding (absorption equivalent to aluminum), suitable for use in natural uranium reactors of the ORGEL type, a solution whereby the pin is subjected to triaxial loading has been employed in order to avoid the difficulty of thermo-mechanical instability, due to buckling of the cladding at high temperature and under the external pressure of the liquid coolant. Preliminary tests have been started. This design entails shaping the thin cladding to render it comparatively flexible and using fuel pellets surrounded by a plastic cushion (in this case magnesium) which is under complete hydrostatic conditions. The preliminary tests related to the fabrication of fuel elements clad with commercial corrugated diaphragms in thin stainless steel and subjected to various thermal shocks. These initial results, which are encouraging as regards the principles, led to a study on the shaping of stainless-steel claddings (dia. 15 mm, thickness 0.1 mm) and to the fabrication of a few elements which were subjected to temperature

fluctuations of 550°C in water without suffering any appreciable deformations or any ruptures. Various technological problems were encountered and satisfactory solutions found for some of them, such as the closure of the claddings. (auth)

39812 (EURAEC-1108) DEVELOPMENT OF PROCESSES FOR PRODUCTION OF UC BASED URANIUM CARBIDES AND CERMETS. Quarterly Report No. 16, April 1–June 30, 1964. P. Himmelstein, H. Kroll, B. Liebmann, and L. Schaefer (Nuklear-Chemie und -Metallurgie G.m.b.H., Wolfgang bei Hanau am Main, Germany). Work Performed under United States–Euratom Joint Research and Development Program. Contract 088-62-7-RDD. 2p.

Attempts were made to improve the melting conditions inside the skull-melting tilting furnace. Favorable results were achieved by the use of specific current supply in the crucible-skull combination by a magnetic centering field, combined with constructive improvements of the copper crucible. When melting UC residue inside an otherwise quietly burning arc, contrary to pellet melting the burning point on the electrode was mobile and gave rise to a higher electrode burn-up. The mass spectroscopic examination of the furnace atmosphere showed that when melting pure residue instead of pellets the CO content of the furnace atmosphere was lower. Control of the argon furnace atmosphere and its correction by means of additional carbon monoxide stabilized the burning point and reduced the electrode burn-up. (auth)

39813 (GEAP-4462) STRAIN-CYCLE PHENOMENA IN THIN-WALL TUBING. Myron B. Reynolds (General Electric Co. Vallecitos Atomic Lab., San Jose, Calif.). Jan. 30, 1964. Contract AT(04-3)-189. 30p.

The service life of a nuclear reactor fuel element is related to the ability of its metallic cladding to accommodate severe local plastic strains caused by fuel expansion or external coolant pressure. A technique has been developed for subjecting samples of thin-wall tubing to cyclic plastic strains similar to those experienced in reactor service. By applying gas pressure, the thin tubular specimen is alternately expanded and contracted between rigid concentric mandrels until failure occurs as indicated by gas leakage. Relative cyclic strain range is determined by mandrel dimensions, specimen diameter, and specimen wall thickness. At larger strain ranges, deformation occurs by reverse bending rather than by simple tension and compression. These tests have been made at 1300°F on specimens of Hastelloy-X, Inconel-600, Incoloy-800, and Type-304 stainless steel; the last two in-reactor as well as in the laboratory. Specimen life in cycles to failure, N was found to be related to strain range $\Delta\epsilon_0$ computed from mandrel dimensions by $N^{\alpha}\Delta\epsilon_0 = C$, in which α varied from 0.6 to 1.35 and C from 0.14 to 3.3 depending on material. Effective strain range was found to be less than $\Delta\epsilon_0$ because of specimen wrinkling. The fatigue life of Incoloy-800 and Type-304 stainless steel was somewhat reduced by testing in fast neutron radiation. Specimen failure was by longitudinal cracking, with little evidence of gross plastic deformation, although there was evidence of deformation within the grains of the alloy in the vicinity of cracks. (auth)

39814 (GEAP-4532) EXPERIMENTAL EVALUATION OF DECONTAMINATION PROCEDURES FOR THE PRESSURIZED-WATER LOOP. N. Michael (General Electric Co. Vallecitos Atomic Lab., San Jose, Calif.). May 27, 1964. Work Performed under United States–Euratom Joint Research and Development Program. Contract AT(04-3)-189. 18p. (EURAEC-1160)

Decontamination tests were performed on test coupons exposed in the Pressurized-Water Loop for 18 months (5,500 effective fuel power hours) under loop coolant conditions of 345°F, 1200 psi, pH 9.5 to 10.0, and <50 ppB dissolved oxygen. Radioactive contamination was found to include uranium, fission products, and corrosion products. Decontamination treatments were evaluated that involved three steps. With stainless steel the first step was a treatment with nitric acid solution. The second and third steps were the same for both materials, an alkaline-permanganate treatment followed by acid sulfate (Wyandotte 5061). The overall decontamination of both stainless and carbon steels was eminently successful (99.9% removal of the initial gamma activity from stainless steel and 99.4% removal from carbon steel). However, the Step 1 treatments, designed to dissolve UO_2, proved to be unnecessary for achieving satisfactory decontamination. The defilming action of the alkaline permanganate-acid sulfate combination treatment readily removed the alpha activity (associated with uranium contamination) as well as the gamma activity. Metallographic examination of weldments between stainless and carbon steel treated in each of the solutions for 1 hour exhibited no sign of incipient cracks or other localized attack, with the possible exception of areas contaminated with welding slag, where micro pits of 1.2-mil maximum penetration were noted. (auth)

39815 (GEMP-38A) HIGH-TEMPERATURE MATERIALS PROGRAM PROGRESS REPORT NO. 38, PART A. (General Electric Co. Advanced Technology Services, Cincinnati). Aug. 19, 1964. Contract AT(40-1)-2847. 40p.

Further studies of the kinetics of the radiation-induced expansion provided confirmation of the analysis presented in a previous report. Some aspects of the kinetics were placed on a broader experimental basis through modification of the expansion equations which enabled computation of the annealing rate constants for specimens that involved grain-boundary separation. Analysis of the lattice expansion data led to an equation for diffusion of interstitial defects and indicated an interstitial migration energy during irradiation of about 18 kcal. He analyses, while not conclusive, indicated that He diffusion during irradiation may be associated with vacancy migration. The equipment for anodizing and stripping arc-cast Ta was constructed and tested. A power supply with a higher amperage output was obtained. Autoradiographic and anodization studies were initiated on samples containing ^{85}Kr which was introduced by the glow-discharge process. A can made of arc-cast Ta was evacuated and subsequently heated in an atmosphere of krypton containing ^{85}Kr for 36 hours at 2400°C with no permeation or diffusion of Kr being detected. BeO-fuel elements containing 8.5 to 11.5 vol % $UO_2-ThO_2-Y_2O_3$ showed little or no UO_2 loss; in 1000-hour fuel retention tests at 1200, 1300, and 1400°C in air, those fueled with UO_2-ThO_2 consistently lost more fuel. Fuel elements fueled with 25 vol % $UO_2-ThO_2-Y_2O_3$ showed no UO_2 loss in 660 hours at 1200°C. After 450 hours at 1200°C in flowing He, fuel elements fueled with UO_2-ThO_2 and $UO_2-ThO_2-Y_2O_3$ had insignificant weight changes, indicating no loss of UO_2. Experimental results from fueled BeO specimens sintered at 1675 or 1800°C indicate that the higher sintering temperature increases the initial oxidation rate and decreases fuel loss in Y_2O_3-containing specimens. Compressive creep rates for BeO fueled with 25 vol % $UO_2-ThO_2-Y_2O_3$ are higher than predicted by the Nabarro-Herring model at temperatures above 1300°C. (auth)

39816 (HW-66017) EXPERIMENTAL PRODUCTION OF PLUTONIUM POWDER BY MECHANICAL COMMINUTION. V. G. Eschen and M. H. Curtis (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). July 8, 1960. Contract AT(45-1)-1350. 10p.

Production of plutonium powder was accomplished by mechanical comminution with a ball mill and a hammer mill. Ball milling was performed dry. Very little contamination due to the grinding media and container occurred. Oxygen contamination during ball milling did not appear to be excessive. Analysis of a sample from one run showed the oxygen content to be 868 ppm. The size distributions of the ball-milled powders were obtained. Apparent density of the powder was 4.5 g/cc. Visual examination of the powder particles indicated the particles produced by mechanical means were flat and irregular in nature. Ball milling time required to produce the powders was approximately 50 hours for 75-gram batches. Contamination from porcelain balls prohibits their use. No significant contamination resulted from using aluminum oxide balls for the milling operation. The particle size distribution of powder produced in the hammer mill was obtained. The powder obtained in the hammer mill had a larger percentage of fines than the ball milled powder. Plutonium Metallurgy Operation is producing powder compacts in order to evaluate the particle size and characteristic requirements. Results to date are inconclusive. (auth)

39817 (HW-77531) CHARACTERISTICS OF BURNING PLUTONIUM. R. K. Hilliard (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Apr. 23, 1963. Contract AT(45-1)-1350. 8p.

Information is given which can be used as a basis for estimating the release characteristics of plutonium during a fire involving an exterior energy source such as gasoline or a flammable building. The metal would ignite when its temperature was raised to 200–500°C, depending on its area/weight ratio. The maximum temperature attained by self-heating would depend on the area/weight ratio, heat transfer capabilities, and the extent of external heating. With multi-kilogram quantities of plutonium involved, it is probable that the metal would continue to oxidize slowly for hours to days unless extinguished by suitable means. The release of PuO_2 particles to the atmosphere would depend on two factors: (1) the particle size distribution of the oxide formed, and (2) the dispersal mechanisms available. The size distribution depends on the oxidation temperature, with courser material being formed at higher temperatures. Area/weight ratio of the metal may also influence the size distribution. Dispersal mechanisms include thermal up-drafts created by the fire, gusty winds, falling building structures and explosions. Possibly, the oxidizing plutonium would be shielded from these dispersing actions by containing vessels, building walls, or fire debris. In the absence of knowledge concerning the maximum dispersal mechanisms which can be expected, an ultra-safe assumption is that all of the oxide will be dispersed. Then, on the basis of the most hazardous laboratory particle size distribution data now available, it can be estimated that <0.1 per cent of the PuO_2 would behave as an aerosol and travel more than a few hundred yards downwind. (auth)

39818 (IDO-24461) DIFFERENTIAL THERMAL EXPANSION TESTS ON ADVANCED TEST REACTOR FUEL PLATES. Research Report No. 5449. R. E. Deville (Babcock and Wilcox Co. Research Center, Alliance, Ohio). Oct. 15, 1963. Contract AT(10-1)-1075. 14p.

Curved ATR fuel plates clad with 8001-0 and 6061-0 aluminum and with a radius of curvature of 3.201 and 5.249 inches, were tested along with flat plates. The test conditions subjected the plates to compressive thermal stresses expected during reactor operation at temperatures to 800°F, and the plate contour was measured to detect any ripples. No significant ripples were formed on any of the curved fuel plates; the maximum deflection was ~20 mils. On the other hand, the flat plates formed a ripple pattern with a maximum peak-to-peak value of 120 mils, indicating that curvature of the plates prevents rippling. No rippling occurred in an 8-day creep test at 500°F. (D.L.C.)

39819 (IITRI-B6019-5) HIGH-TEMPERATURE OXIDATION-PROTECTIVE COATINGS FOR VANADIUM-BASE ALLOYS. Bimonthly Report, June 1–July 31, 1964. Larry I. Kane and John J. Rausch (Illinois Inst. fo Tech., Chicago. IIT Research Inst.). Sept. 1, 1964. Contract NOw-64-0140-c. 23p.

Progress is reported in a program to develop oxidation-protective coatings for V-base alloys for use at 1800 to 2500°F. The effect of pack-siliconizing on the mechanical properties of 0.020-in.-thick sheet of V–60 Nb–1 Ti (weight per cent) is being studied. Results indicate that the siliconizing process has little effect on strength but causes some reduction in tensile ductility. However, good ductility is noted at temperatures as low as –320°F. Preliminary results indicate that there is no embrittlement of this coated sheet after twenty-five 4-hr oxidation cycles at temperatures up to 2300°F. The development of an oxidation-resistant slurry or liquid cementation type of coating for V–60 Nb–1 Ti is progressing. Slurry compositions containing Sn, Si, Ag, Cu, Al, and Nb were investigated; several of these show good coverage, even at corners and edges. The static oxidation life of other V-base alloys, coated by the pack-siliconizing process, is also being investigated. V–40 Nb–30 Ta–1 Ti, the most promising of these alloys, has an oxidation life of about 50 hr at 2200°F, and less under cyclic conditions. (auth)

39820 (IS-845) URANIUM GLASSES. D. R. Wilder, M. A. Carrell, and C. D. Wirkus (Ames Lab., Ames, Iowa). [Feb. 1964]. Contract [W-7405-eng-82]. 32p. (CONF-506-3)

From Symposium on Compounds of Interest in Nuclear Reactor Technology, Boulder, Colo., Aug. 1964.

Uranium glasses are considered as potential nuclear materials. The structures of phosphate, silicate, and borate uranium glasses are analyzed and discussed. The chemical properties of uranium glasses are reviewed and the physical properties of the known uranium glasses are discussed. (auth)

39821 (IS-875) TERNARY METAL–CARBON–HYDROGEN COMPOUNDS OF SOME TRANSITION METALS. J. Rexer and D. T. Peterson (Ames Lab., Ames, Iowa). [Apr. 1964]. Contract [W-7405-eng-82]. 29p. (CONF-506-1)

From Symposium on Compounds of Interest in Nuclear Reactor Technology, Boulder, Colo., Aug. 1964.

The metal-carbon-hydrogen systems of titanium, zirconium, hafnium, yttrium, lanthanum, and vanadium were studied by measuring hydrogen equilibrium pressures at various compositions and temperatures. Compounds with the approximate stoichiometry $MC : MH_x$ were found and characterized for each of these metals. The metal atoms in the $MC : MH_x$ compounds are arranged on a hexagonal closest packed lattice. The compounds have a wide range of hydrogen content. The hydrogen equilibration of V_2C resulted in an expansion of the lattice rather than the ap-

pearance of a new phase. The enthalpies of the reaction producing the ternary compounds of titanium, zirconium, and hafnium were determined. (auth)

39822 (LA-DC-6401) FUSED-SALT ELECTROREFINING OF MOLTEN PLUTONIUM AND ITS ALLOYS. L. J. Mullins and J. A. Leary (Los Alamos Scientific Lab., N. Mex.). [1964]. Contract W-7405-eng-36. 38p. (CONF-653-2)

From American Chemical Society Symposium, Chicago, Sept. 1964.

Results of an extensive development program that culminated in construction of a 40 kg per month capacity electrorefining plant are reviewed. High purity plutonium is produced in good yield on the 0.2 to 3.5 kg scale. Impure plutonium metal, plutonium-10 atom percent iron alloy, and plutonium-3.25 atom percent gallium alloy have been refined routinely to plutonium that contained less than 100 ppm of metallic impurities. In addition to serving as a means of preparing high purity plutonium metal, the large scale process is used to recycle plutonium metal scrap economically. The theory of plutonium alloy electrorefining is developed. In particular the behavior of elements that are commonly present in impure plutonium metal, such as uranium, thorium, iron, and gallium, is reviewed. The special case of americium-241, which results from the decay of plutonium-241, is considered in detail. The distribution coefficients for americium between the molten salt electrolyte and the refined plutonium are reported. Results are correlated with thermodynamic properties and phase diagrams of plutonium alloy systems. The effects of process variables such as refining temperature, current density, molten salt electrolyte composition, and stirring on the process are discussed. In addition, various ceramics and refractory metals have been evaluated as container materials for molten salts and molten plutonium. (auth)

39823 (NAA-SR-Memo-9749) THERMAL RADIATIVE COATINGS FOR SNAP-8 FLIGHT SHIELD. L. Maisel (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Mar. 31, 1964. Contract [AT(11-1)-Gen-8]. 17p.

A compilation of data is presented on thermal radiative properties of various finishes which may potentially be utilized for a combination of emissivity control and environmental protection of the SNAP 8 Flight Shield. Aspects of adequacy as to the aforementioned are discussed with some emphasis on methods of application of fabrication techniques. The finish systems investigated are inorganic in nature and include: electro-deposited cermets, anodized aluminum coatings, aluminum–silicon coatings, porcelain enamel systems. It is concluded that porcelain enamel coatings and Cr_2O_3 appear to possess the required properties. (D.L.C.)

39824 (NASA-TN-D-2039) DIFFUSION STUDIES OF SEVERAL OXIDATION-RESISTANT COATINGS ON Mo–0.5Ti MOLYBDENUM ALLOY AT 2,500°F. Bland A. Stein and W. Barry Lisagor (National Aeronautics and Space Administration. Langley Research Center, Langley Field, Va.). Aug. 1964. 36p.

Results of a study on the diffusion effects of several silicide-base coatings on Mo–0.5Ti molybdenum-alloy sheet are presented. The magnitude of substrate thickness loss due to solid-state diffusion at 2500°F is presented; this indicates the possible need for diffusion barriers between coating and substrate in some applications. The phase changes in the coating during exposure at 2500°F in air were studied to obtain an understanding of coating behavior. The phases which formed were identified by x-ray diffraction techniques. From these identifications an explanation is given for the superior oxidation protection of one of the coatings. (auth)

39825 (NASA-TN-D-2040) A STUDY OF SEVERAL OXIDATION-RESISTANT COATINGS ON Mo–0.5Ti ALLOY SHEET AT 2,500°F. Donald R. Rummler, Bland A. Stein, and Richard A. Pride (National Aeronautics and Space Administration. Langley Research Center, Langley Field, Va.). Aug. 1964. 78p.

Results are presented of a study of several silicide-base oxidation-resistant coatings applied to 0.012-inch-thick molybdenum-alloy sheet. The specimens were both continuously and cyclically exposed at 2500°F in air. The effect of three different types of thermal cycles was investigated. A failure mechanism is proposed to explain the severe reduction observed in the ability of a coating to protect the substrate when thermally cycled. A failure mechanism for the continuously exposed coated specimens is also proposed. The investigation includes the results of x-ray studies and room-temperature mechanical-property tests on the coated specimens. (auth)

39826 (ORNL-3674) CONTAMINATION OF REFRACTORY METALS BY RESIDUAL GASES IN VACUUMS BELOW 10^{-6} TORR. H. Inouye (Oak Ridge National Lab., Tenn.). Sept. 1964. Contract W-7405-eng-26. 37p.

The contamination of niobium, molybdenum, tantalum, Nb–1% Zr, FS-85, D-43, Cb-752, TZM, and T-111 resulting from their extended exposure to the residual gases in high vacuums was measured by chemical analyses. This contamination was characterized in terms of the system pressure, metal temperature, exposure time, metal surface-to-volume ratio, and alloy composition. A second phase of the study was concerned with developing techniques for lowering the contamination of Nb–1% Zr with refractory metal envelopes, vapor-plated molybdenum, and intentional additions of nitrogen or CH_4 to vacuum atmosphere to counteract the noxious gases. The residual gases in the vacuum system operating at pressures between 10^{-6} and 10^{-8} torr were mainly hydrogen, H_2O, CO, CH_4, nitrogen, and CO_2. The oxidizing gases at these pressures caused significant amounts of oxygen contamination of the above alloys when heated for 1000 hr between 600 to 1200°C. Although carburization also occurred, a competing carbon-oxygen reaction became important at the higher temperatures and caused decarburization of some of the alloys. The presence of titanium, zirconium, and hafnium in the above alloys promoted oxygen contamination while additions of tungsten and tantalum had no influence. Hydrogen and nitrogen contamination was not a problem. Refractory metal envelopes effectively stabilized the carbon content of Nb–1% Zr but were erratic in their ability to lower the oxygen contamination. Molybdenum deposits $<5 \times 10^{-5}$ in. thick produced by the reduction of $MoCl_5$ provided complete protection of the alloy up to 1062°C. Low concentrations of CH_4 added to the residual gases in the vacuum system lowered the oxygen contamination of TZM and niobium. It was concluded that the contamination of refractory metals was controlled by four test variables: pressure, temperature, time, and sample thickness. For the temperature range investigated, the maximum permissible pressures are estimated to be near 10^{-9} torr for thin metal sections exposed for extended periods. Through the additional use of secondary control measures, such as metal barriers, metal surface

deposits, and gas additions to the residual gases, the permissible atmospheres for niobium and tantalum alloys could be expanded to higher impurity concentrations and environments of inert gases. Furthermore, the present results indicate that it may be feasible to control the interstitial content of the alloys during heat treatment with suitable gas additions. (auth)

39827 (TID-21093) EFFECTS OF NEUTRON DAMAGE ON THE MECHANICAL PROPERTIES OF PYROLYTIC AND SINGLE-CRYSTAL GRAPHITE. Quarterly Progress Report No. 1, April 1–June 30, 1964. J. T. Meers (Union Carbide Corp. Carbon Products Div. Research Lab., Parma, Ohio). Aug. 1964. Contract AT(40-1)-3237. 51p.

The initial work was on the production, characterization, and measurement of the mechanical properties of unirradiated graphite single crystals and pyrolytic graphite which was stress-annealed to align the crystallite c-axes. Several methods of growing graphite single crystals and several combinations of stress-annealing conditions were tried. Material characterization has included x-ray methods, optical and electron microscopy, and a new optical reflectivity technique. A tensile testing machine for single crystals was designed, and techniques for preparing millimeter-size specimens were devised. Preliminary tension and compression stress-strain tests, using resistance strain gages, were made on both as-deposited and stress-annealed pyrolytic graphite. Values for all elastic compliance and engineering constants except s_{44} are given for several specimens of as-deposited pyrolytic graphite. A preliminary value of 100×10^6 lb/in.^{2} was obtained for the Young's modulus parallel to the basal plane of stress-annealed pyrolytic graphite. Ultrasonic and resonant bar methods were combined to give values for all five elastic constants of the as-deposited pyrolytic graphite. Preliminary values of all elastic stiffness constants except c_{13} are given for a sample of stress-annealed pyrolytic graphite. (auth)

39828 (UNC-5080) THE DEVELOPMENT OF URANIUM CARBIDE AS A NUCLEAR FUEL. Final Report. J. Crane and E. Gordon (United Nuclear Corp. Development Div., White Plains, N. Y.). Feb. 29, 1964. Contract AT(30-1)-2374. 80p.

Methods of fabricating uranium carbide by powder metallurgy and skull arc casting techniques were developed, out-of-pile property measurements from room temperature to 1000°C were performed, and the irradiation behavior of uranium carbide was evaluated. The powder metallurgy route utilizes the reaction of an alkane gas with uranium metal powder to synthesize the carbide powder which is subsequently cold pressed and sintered. The sintered product contained less than 1000 ppm oxygen and less than 300 ppm nitrogen. The processes developed, which yielded 4.8 wt % carbon solid bodies of 90 to 94% of theoretical density and 4.3 to 4.4 material up to 98% of theoretical, are described. The skull arc melting and casting process employs prereacted UO_2-graphite for feed stock. It was shown that such carbide feed material containing high residual oxygen and free carbon could be reproducibly melted in an inert atmosphere with carbon control to better than ±0.1 wt % and a product containing less than 400 ppm oxygen and less than 100 ppm nitrogen. Both powder metallurgy and casting methods have production capability. Thermal expansion measurements reported showed that from 500 to 1000°C 4.4 and 5.2 wt % carbon materials have slightly higher coefficients than UC, and expansion of cast materials is slightly higher than sintered carbide of equivalent carbon content. The average coefficient of linear expansion from room temperature to 1000°C for all types of carbide tested is within the range of 11.1 to 11.8×10^{-6} per °C. Thermal conductivity measurements indicated that the conductivity coefficient decreases slightly as a function of temperature to 400°C and then rises steadily to 1000°C. Detailed values given in this report show the 4.4 cast material to have the highest coefficient at 1000°C (0.31 watts/cm-°C) and the 4.8 sintered the lowest (0.22 watts/cm-°C). Electrical resistivity vs temperature curves are shown for 4.4 and 5.2 cast and 4.4 and 4.8 sintered uranium carbide. All exhibit a resistivity increasing with temperature at a decreasing rate. The maximum resistivity was 200 μohm-cm at 1000°C for the 4.8 sintered material. Hardness measurements taken at room temperature and from 500 to 1100°C are tabulated. Results showed that above 500°C the 5.2 material is superior to all other types tested. At 800°C the 4.4 material was too soft to test. The irradiation behavior of uranium carbide at burnups ranging from 14,300 Mwd/t U (2 at. %) to 40,100 Mwd/t U (5 at. %) at fuel surface temperatures of 625 to 1000°C and fuel centerline temperatures of 1000 to 1350°C is described in detail. The data indicate that the 5.2 wt % carbon material can withstand burnups up to 36,000 Mwd/t U at 1100 to 1200°C with release of only 5% of the total fission gas formed and diametral swelling of 1.5% per at. % burnup. The 4.8 material showed somewhat poorer behavior but was substantially better than the 4.4 fuel. Uranium carbide under these test conditions was found to be compatible with Nb–1 wt % Zr in all cases except one which could be avoided by capsule design modification. In general, in-pile and out-of-pile behavior of uranium carbide was found to be more sensitive to carbon content than fabrication method. In many cases, differences in behavior were associated with the characteristics of free uranium at the specific conditions of test. The work described shows clearly that designers anticipating the use of uranium carbide for reactor applications must consider the specific carbide fuel which will best meet their performance requirements and not think in terms of uranium carbide generally. (auth)

39829 CONTRIBUTION TO THE STUDY OF THE PURIFICATION OF URANIUM BY ZONE AND STATIC MELTING. Ph Van Asbroeck. ATB (Acta Tech. Belg.) Met., 4: No. 3, 53-64(1963). (In French)

Purification by zone melting was applied to uranium. The elimination of two types of impurities was studied: the impurities generally present in the metal as it is prepared and the fission products of irradiated uranium. The efficiency of the purification was measured by the distribution coefficient, the value of which was determined for some impurities, traveling speed of the melted zone having extreme values of 5 and 20 mm/hr. The elimination of impurities can also be obtained by methods other than zone melting such as scorification and distillation. These methods are studied by static melting. (Rev. Metal Lit., 21: No. 7, July 1964)

39830 TECHNOLOGICAL AND RADIATION HYGIENE EXPERIENCES GAINED IN THE EXPERIMENTAL PILOT-PLANT PREPARATION OF Sr^{90} GLASS. L. Adam, L. Kovacs, and I. Lovanyi, Banyasz. Kut. Int. Kozlemen., 7: 217-28(1962). (In Hungarian)

Studies showed that ^{90}Sr could be incorporated as stable SrO into inactive glass that was not water-soluble (hydrolytic group I). The glass contained 2% ^{90}SrO. The radioactive component was added to the glass as the last ingre-

dient, in several small portions. This radiation source should have all the desirable and advantageous properties of glass: insoluble, unabsorbable by the body, no clinging contamination, and resistance to atmospheric and chemical corrosion. The technical aspects and problems of preparing the radioactive glass and the radiation health hazards involved in the process are also described. (TCO)

39831 CRYSTALLIZATION OF BERYLLIUM IN A CONDENSING COLUMN. I. I. Papirov and G. F. Tikhinskii (Khar'kov Inst. of Physics and Tech.). Soviet Phys.-Cryst. (English Transl.), 9: 247-50(Sept.-Oct. 1964). Translated from Kristallografiya, 9: 310-14(Mar.-Apr. 1964).

The growth of Be crystals from the vapor in a condensing column with temperature gradient was studied under practical vacuum distillation conditions. It was established that increasing the evaporator temperature, thus raising the density, of the flow of vapor led to an increase in crystal size and to a certain redistribution in the various zones of crystals in the condenser according to their morphological type. No essential changes in the crystal boundaries were observed. Dendrite crystals formed in the regions of maximum supersaturation, and with increasing T_{ev} they formed at higher values of T_{con}. The largest crystals with well expressed facets (size up to 10 mm) were formed for T_{ev} = 1350°C and T_{con} = 1150°C; in the colder regions (T_{con} < 900°C) the crystals were of sizes ~ 0.1 mm. The crystals were found to be extremely sensitive to small changes in the conditions of crystallization. (P.C.H.)

39832 PREPARATION OF ZIRCONIUM BORIDE. V. F. Funke and S. I. Yudkovskii. Soviet Powder Met. Metal Ceram. (English Transl.), No. 4, 293-6(Aug. 1963).

It is shown that ZrB_2 of the stoichiometric composition, containing an insignificant amount of impurities, can be produced commercially pure from starting materials (B_4C, ZrO_2). A study was made of the effect of the composition of the starting materials on the conditions of preparation and chemical and phase compositions of ZrB_2 prepared by reacting ZrO_2 with B_4C and carbon black. (Rev. Metal Lit., 21: No. 7, July 1964)

39833 REACTION OF TUNGSTEN CARBIDE WITH OXIDES OF REFRACTORY METALS IN A VACUUM. G. P. Shveikin. Soviet Powder Met. Metal Ceram. (English Transl.), No. 6, 454-7(Nov.-Dec. 1962).

The carbothermic process for the production of refractory metal alloys by reacting their oxides with carbides was evaluated. The reaction of WC with Cr_2O_3, V_2O_3, Cb_2O_5, Ta_2O_5, TiO_2, and ZrO_2 at 1300 to 1400°C was used. (Rev. Metal Lit., 21: No. 7, July 1964)

39834 7e COLLOQUE DE MÉTALLURGIE. ÉCROUISSAGE, RESTAURATION, RECRISTALLISATION. (7th Conference on Metallurgy. Cold-Working, Recovery, Recrystallization). Gif-sur-Yvette, France, Centre d'Études Nucléaires de Saclay, 1963 and Paris, Presses Universitaires de France, 1963. 208p.

Proceedings of the Seventh Conference on Metallurgy (Cold-Working, Recovery, Recrystallization) are presented. Seventeen papers are included and a separate abstract was prepared for one paper. (M.C.G.)

39835 CONTRIBUTION TO THE STUDY OF MAGNESIUM, ZIRCONIUM, BERYLLIUM AND ZINC BEHAVIOR DURING ALTERNATIVE PLASTIC DEFORMATIONS. N. Azam, G. Didout, J.-P. Lauque, Ph. Sanchez, and M. Weisz. p.79-95 of "7e Colloque de Metallurgie. Ecrouissage, Restauration, Recristallisation." Gif-sur-Yvette, France, Centre d'Études Nucléaires de Saclay, 1963 and Paris, Presses Universitaires de France, 1963.

The behavior, in alternative plastic fatigue of the traction-compression type, of various metals crystallizing in the close-packed hexagonal system (Mg, Zr, Be, Zn) was studied. Work was chiefly carried out on a magnesium–zirconium alloy (0.5% Zr) used in France for canning of fuel elements. The shape of the Wöhler's diagram, influence of fatigue on the mechanical properties, types of fracture of this material is described and attempts made to explain this behavior. (auth)

39836 THE ROLE OF CANADIAN URANIUM IN THE WORLD NUCLEAR INDUSTRY. James A. L. White. Toronto, Canadian Nuclear Assn., 1964. Preprint 64-CNA-118, 10p. (CONF-539-14)

From Canadian Nuclear Association Conference on Canada's Role in a World of Expanding Nuclear Industry, Toronto, May 1964.

The size and reserve base of the major world suppliers of uranium as they exist today are examined, and attempts were made to assess the potential of the uranium industry in these nations as it may exist relative to future demand. The nations discussed, include Canada, the United States, South Africa, Australia, France, and Japan. It is expected that world demand for uranium will rise from 13,000 tons of U_3O_8 in 1970 to 53,000 tons in 1980. However, these figures include no allowance for military demand or for marine propulsion that could add significantly to demand, nor do they include plutonium recycling or use of thorium, which would lower demand. It is believed that the uranium ore reserves of Canada, coupled with demonstrated low costs and stable political climate, will soon be playing a crucial role in the development of nuclear power. (P.C.H.)

39837 FACTORS AFFECTING THE COST OF NUCLEAR QUALITY ZIRCONIUM ALLOY FUEL SHEATH TUBE. Stephen J. Adams (Calumet and Hecla, Inc., Allen Park, Mich.). Toronto, Canadian Nuclear Assn., 1964, Preprint 64-CNA-112, 25p. (CONF-539-10)

From Canadian Nuclear Association Conference on Canada's Role in a World of Expanding Nuclear Industry, Toronto, May 1964.

Typical specification requirements for zirconium alloy nuclear fuel cladding seamless tube are reviewed. It is shown how these requirements affect costs, and modifications that, while still ensuring the same high degree of quality and product reliability, will reflect in cost reduction are suggested. (P.C.H.)

Corrosion

Refer also to abstract 40888.

39838 (EURAEC-1041) IMPERFECTIONS IN METALS. II. CORROSION AND OXIDATION. Quarterly Report No. 6, January 1–March 31, 1964. (Centre d'Étude de l'Énergie Nucléaire, Mol, Belgium). Work Performed under United States–Euratom Joint Research and Development Program. Contract 082-62-7-RDB. 22p. (R-2287)

A transformation process in the solid solution of O_2 in Nb is studied by means of electron microscopy and diffraction. Several stages of the process were found by treating the thin foils in the electron microscope. The first step consists of a nucleation phenomenon. Nuclei are formed which are composed of small parallel domains of an ordered phase. The domain boundaries on a {100} plane have the

two perpendicular ⟨110⟩ directions. Lateral growth of the nuclei occurs until the whole region is covered with a cross-hatched pattern. Selected area diffraction shows the presence of many supplementary spots in a regular array between the Nb spots. The phenomenon is explained by ordering of the O_2 interstitials on a superlattice of the matrix, and shows striking similarity with the domains observed in Nb foils that were treated as bulk material. Larger lenticular domains were also observed. They show internal boundaries of the twin type, whish lie in {110} planes. A further stage is associated with the appearance of larger platelets which are also oriented in crystallographic directions. Selected area diffraction over these areas show no significant difference from the previous stage. Irregularly shaped nuclei were observed in the same area, having a superstructure of the Nb lattice. The lattice spacing corresponds to twice the Nb spacing. One of the suboxide phases, NbO_z, was observed as platelets growing in ⟨110⟩ directions on a {111} foil. This suboxide phase was epitaxially related to the Nb lattice. It is supposed that all observed phenomena represent an intermediate stage in the transformation to the suboxide and oxide phases of Nb. (auth)

39839 (EURAEC-1116) QUARTERLY REPORT NO. 8 [ON CORROSION OF STAINLESS STEELS UNDER STRESS], APRIL 1–JUNE 30, 1964. G. Chaudron [France. Centre National de la Recherche Scientifique, Paris]. Work Performed under United States–Euratom Joint Research and Development Program. Contract 085-62-7-RDF. 16p.

A survey was conducted of the corrosion of stainless steels under stress, taking into consideration the electrochemical phenomena that accompany this type of corrosion. The development of the curves on the function of time in the dissolution of various stainless steels submitted to tensile stress in a solution of boiling $MgCl_2$ are reported. A special cell developed for this purpose is described. It was noted that the breaking of the samples is always preceded by an enrichment of the dissolution potential. The kinetics of this enrichment depend mostly on the purity of the stainless steel. For an austenitic structure, the period of incubation is longer for high-grade alloys. The enrichment of the potential is also produced in the case of the alloys in the austeno-martensitic state but it is not followed by the breaking of the samples. A survey of various steels by electron microscopy of thin metal foil was also undertaken. The results of the first observations in connection with the recrystallized state and with the weakly cold-rolled state are presented. Development of a new high-grade $^{18}/_{10}$ alloy (alloy No. 9), which contains an addition of about 1% of Si is reported. This new steel must permit an evaluation of the influence of Si on the phenomena of corrosion under stress and of intercrystalline corrosion in boiling nitric acid to which hexavalent Cr has been added. (auth)

39840 (GEAP-4521) CORROSION MECHANISM OF ZIRCONIUM AND ITS ALLOYS. III. SOLUTE DISTRIBUTION BETWEEN CORROSION FILMS AND ZIRCONIUM ALLOY SUBSTRATES. D. L. Douglass (General Electric Co. Vallecitos Atomic Lab., San Jose, Calif.). Apr. 1, 1964. Work Performed under United States–Euratom Joint Research and Development Program. Contract AT(04-3)-189. 27p. (EURAEC-1181)

Analyses of stripped corrosion films were performed by wet chemical methods, activation, and microprobe analysis. It was found that the amount of Sn, Nb, and Cr in post-transition oxide films was directly proportional to the amount in the alloy. There was no measurable difference in film composition of a given alloy as a function of film thickness, and the combination of alloying elements in ternary alloys had no effect on the amount of a given element in the corrosion film. Analyses of a pre-transition film in a Zr–1Cr binary alloy were made by using a tracer, ^{51}Cr. No concentration differences in Cr were found in corrosion films formed in 400°C steam over a range of thickness from 7000 to 18,000 Å. It was concluded that this alloy did not exhibit concentration changes in the substrate adjacent to the oxide film as found by Wagner for Ni–Pt alloys and that diffusion of Cr in the metal was unimportant for this particular case. The beneficial effect of Cr and harmful effect of both Sn and Nb on post-transition corrosion rates can be associated with the amount of solute in the film, although no suitable mechanism for these effects can be found at present. (auth)

39841 (HW-80658) CORROSION OF 304-L STAINLESS STEEL AND HAPO-20 IN ACID-FLUORIDE SYSTEMS. R. F. Maness (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Jan. 31, 1964. Contract AT(45-1)-1350. 19p.

A summary of corrosion data on 304-L stainless steel and HAPO-20 in boiling solutions of HNO_3–HF, HNO_3–HF–$Al(NO_3)_3$, and HNO_3–HF–$Th(NO_3)_4$ is presented. (J.R.D.)

39842 (LA-3101) CORROSION OF STAINLESS STEELS BY WATER BOILER REACTOR FUELS. Harold M. Busey and Ralph H. Perkins (Los Alamos Scientific Lab., N. Mex.). June 16, 1964. Contract W-7405-eng-36. 25p.

Type 316, 316-L, 321, and 347 stainless steels were corrosion tested in both nitric and phosphoric acid solutions for 3 years. These tests were made at 95°C under reflux conditions in the presence of air. The 0.05M uranyl solutions contained 0.10M HNO_3 or 0.75M H_3PO_4 to simulate the concentrations that might be used in aqueous homogeneous, water boiler type, nuclear research reactors. Each test coupon contained a weld, and metallographic examinations were made of weld, nonweld, and liquid interface regions of the coupons after the 3 year tests. Photographs of the solution/metal interface are shown. The H_3PO_4 type fuel solution was found to be much less corrosive to these stainless steels than was the HNO_3 solution. Types 316 and 316-L were corroded the least by the phosphate solution. The change in concentration of corrosion-product iron in the Los Alamos Water Boiler is shown for a 15-yr period. (auth)

39843 (NP-9807) CORROSION OF STAINLESS STEELS AND ALLOYS. PART I. STAINLESS STEELS: EUROCHEMIC CORROSION TESTS (EIR-37). PART II. ALLOYS FOR HEAD-END EQUIPMENT: SURVEY OF AVAILABLE INFORMATION (EIR-39). O. Jenne (European Company for the Chemical Processing of Irradiated Fuels, Mol, Belgium). May 20, 1960. 37p. (ETR-81)

Results of a series of corrosion tests conducted to aid in selecting stainless steel for general radioactive service in the Eurochemic plant are presented. Summaries of mean corrosion values obtained in all tests are presented along with results of individual tests. Results indicate that 304L stainless steel and Ti-stabilized type 321 steels are generally superior. Ni-o-nel and Hastelloy F were compared for use in head-end equipment. (J.R.D.)

39844 ELEMENTS OF THE COMPOSITION OF MATERIALS CONTAINING NICKEL WHICH PREVENT DRY CORROSION AT HIGH TEMPERATURES. R.-A. Smith.

Corrosion Anti-Corrosion, 12: 108-15(Apr.-May 1964). (In French)

The results of studies on the effects of the composition of different materials containing Ni and of the temperature on the resistance of these alloys to corrosion are reported. The resistance to oxidation to 1200°C in air, H_2S, $CO_2 + CO$, and SO_2 is analyzed to obtain data on the possibility of modifying the behavior of the metal in the environments. (tr-auth)

39845 CORROSION OF CARBON IN AIR AND IN CARBON DIOXIDE. F. M. Lang (Commissariat à l'Energie Atomique, Paris). Corrosion Anti-Corrosion, 12: 116-19 (Apr.-May 1964). (In French)

The principal factors affecting the kinetics of carbon oxidation are described. Although the degree of graphitization does not appear to be important in this mechanism, the solid and gaseous impurities, the surface developed from the carbon, and the porosity, temperature, and pressure play a preponderant role. (tr-auth)

39846 APPLICATIONS OF SOME ELECTROLYTIC DEPOSITS IN THE FIELD OF NUCLEAR ENERGY. G. Chauvin and H. Coriou (CEN, Saclay, France). Corrosion Anti-Corrosion, 12: 153-65(June 1964). (In French)

The resolution of the problems relative to the deposition of Ni and Cr on U, Ni on an Ag–In–Cd alloy, Ag on Be, and Cu on Zircaloy-2 was discussed. In all cases, by consideration of the treatments of the particular surfaces, it was possible to obtain adherent deposits, not only in the cold, but also after thermal diffusion in the solid state. (tr-auth)

39847 HYDROGEN UPTAKE AND HYDROGEN EMBRITTLEMENT OF ZIRCALOY-2, ZrNb1, AND ZrNb2.5. H. Rubel, W. Debray, and U. Roesler (Siemens-Schuckertwerke AG, Erlangen, Ger.). Nukleonik, 6: 159-68(July 1964). (In German)

The dependence, on the melting process and heat treatments, of hydrogen uptake during corrosion in superheated steam (500°C) was investigated for Zircaloy-2, ZrNb 1, and ZrNb 2.5. A hydrogen absorption curve was found, the principle of which applies to all three alloys. The hydrogen absorption was found between 50 and 75% for Zircaloy-2, approximately 40% for ZrNb 1, and approximately 30% for ZrNb 2 of the hydrogen produced by the corrosion. Relations between the hydrogen absorption curve and the corrosion curve yields conclusions on the formation of the oxide layer. These assumptions can be verified on the basis of annealing studies in a pure hydrogen atmosphere. The dependence of the mechanical properties of Zircaloy-2, ZrNb 1, and ZrNb 2 on hydrogen content was studied. It was concluded that ZrNb alloys are less susceptible to embrittlement than Zircaloy-2, when the reduction of the breaking tension is used as embrittlement mass in the tension studies. For all alloys studied, the cold-worked (25%) state proves particularly favorable with respect to corrosion rate as well as hydrogen embrittlement, the β-anneal (slow-cooling) state particularly unfavorable. (tr-auth)

39848 TUNGSTEN OXIDATION KINETICS AT HIGH TEMPERATURES. R. W. Bartlett (Philco Corp., Newport Beach, Calif.). Trans. AIME, 230: 1097-1103(Aug. 1964).

The rates of oxidation of tungsten were determined at temperatures between 1320 and 3170°C and oxygen pressures to 1 atm using a surface-recession measurement technique. Above approximately 2000°C and 10^{-6} atm the rate was independent of temperature and could be calculated from gas collision theory assuming a constant reaction probability, ϵ, of 0.06. Oxygen molecules reacted at surface sites where oxygen atoms were previously chemisorbed. This provided a direct pressure dependence at low pressures but at high pressures tungsten oxide molecules formed an adjacent gas boundary layer, which lowered the P_{O_2} at the tungsten surface. A correction for this effect using free-convection theory fitted the rate data over the entire oxygen-pressure range from 10^{-6} to 1 atm as well as data using O_2–Ar mixtures. Below 10^{-6} atm and above 2000°C, ϵ decreased with increasing temperature because of desorption of oxygen atoms. Below 2000°C the rate decreased with decreasing temperature at all oxygen pressures following an apparent activation energy of 42 kcal per mole and depending on $(P_{O_2})^n$ with n varying between 0.55 and 0.80. (auth)

39849 CORROSION OF STAINLESS STEEL IN HIGH TEMPERATURE WATER. Tatsuo Maekawa, Masaru Kagawa, Nobuwo Nakajima, and Sadayoshi Nagata (Mitsubishi Atomic Power Industries, Inc., Ômiya, Japan). Trans. Japan Inst. Metals, 5: 22-8(Jan. 1964).

The corrosion of AISI Type 304 (or 304 L) stainless steel in high-temperature water (300°C, 87 kg/cm^2, 1000 hr) was investigated in connection with the carbon content, surface preparation, heat treatment, cold working, etc. An x-ray diffractometer was used to investigate the ferrite formation caused by cold working. Results were compared with those in boiling 40 and 65% nitric acid, 5% sulfuric acid, and copper sulfate-sulfuric acid solutions. Carbon content and heat treatments did not affect appreciably the corrosion resistance of Type 304 (or 304 L) stainless steel in high-temperature water. However, the corrosion was affected significantly by the surface finish. The degree of cold working did not have a direct relation to the corrosion resistance in high-temperature water. However, the ferrite caused by cold working accelerated the corrosion significantly. A consistent relation was found between the corrosion in boiling 5% sulfuric acid and in high-temperature water. However, the corrosion in boiling nitric acid had a poor consistent relation with the corrosion in high-temperature water. (auth)

39850 KORROZIYA KONSTRUKTSIONNYKH MATERIALOV YADERNYKH I TEPLOVYKH ENERGETICHESKIKH USTANOVOK. (Corrosion of Building Materials for Nuclear and Thermal Power Installations). P. A. Akol'zin and V. V. Gerasimov. Moscow, Publishing House on Higher Educational Institutes, 1963. 376p.

A detailed analysis was made of the special properties of materials used for nuclear and thermal power equipment and installations. Characteristic properties of coolants; temperature, radiation, and pressure effects on metal corrosion rates and electrode processes; and corrosion resistance to liquid metal coolants are discussed. Descriptions are given of methods for corrosion and electrochemical investigations at high temperatures and pressures. Effects of external and internal factors on the corrosion and electrochemical behavior of construction materials for boilers, steam generators, and reactors are considered. (R.V.J.)

Fabrication

Refer also to abstract 40858.

39851 (AAEC/E-118) THE VACUUM HOT-PRESSING OF BERYLLIUM. T. E. Clare, P. D. Smith, and W. J.

Wright (Australia. Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales). Mar. 1964. 15p.

The optimum conditions for vacuum hot pressing of Pechiney electrolytic beryllium powder have been established and compacts produced with densities exceeding 99% of theoretical density; these conditions depend markedly on the geometry of the compact and the oxide content of the powders being pressed. Effects of compact geometry, including low densities in long compacts, are associated with loss of pressure through die–wall friction, particularly where the length-to-diameter ratio of the compacts is greater than 0.5. The presence of 2.3% beryllium oxide as a surface film on the particles reduced the final density attained to less than 97% of theoretical when pressing with 1500 lb/in^2 at 1080°C, whereas this density could be attained in unoxidized powder with only 800 lb/in^2 for similar conditions. The narrow size range of the oxidized powder may also have contributed to this difficulty in pressing. (auth)

39852 (AAEC/E-121) SINTERING BY VOLUME DIFFUSION. M. J. Bannister (Australia. Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales). June 1964. 16p.

The process of sintering by volume diffusion was subjected to a critical review. Various stages in the sintering process were identified and it was shown that sintering is most effective when the porosity takes the form of continuous pore channels along three-grain edges. The conditions determining when this stage finishes were derived, and the effect of the subsequent stage on the sintering kinetics was predicted. The available kinetic data for the sintering of BeO were reviewed. (auth)

39853 (AAEC/TM-245) THERMAL CONDUCTIVITY AND THE SINTERING PROCESS. A. Scott (Australia. Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales). May 1964. 10p.

By observing the change in the bulk thermal conductivity of a partially sintered mass of spheres, it may be possible to deduce the cross sectional areas of the interconnecting necks formed between adjacent spheres. An expression for the bulk thermal conductivity (K_b) is derived in terms of the actual thermal conductivity (K_m) of the material of which the spheres are formed. From this expression the ratio of K_b/K_m is known. Values of K_b/K_m are plotted against dA/A, where dA is the cross sectional area of a neck and A is the cross sectional area of a sphere. (auth)

39854 (BM-RI-6509) EXPENDABLE CASTING MOLDS FOR REACTIVE METALS. Standley L. Ausmus and R. A. Beall (Bureau of Mines. Albany Metallurgy Research Center, Ore.). Nov. 1963. 49p.

The development of a completely water-free expendable graphite mold material, useful for reactive metal castings, has been detailed. Mixing and curing variables have been evaluated both by physical testing of the material itself and by castings of titanium, zirconium, and hafnium. The blend of powdered graphite, cornstarch, dextrin, cereal binder, linseed oil, and Carbowax-4000 is a successful mix when mulled in a carbon dioxide atmosphere, and properly cured and fired. The primary advantage of this material is its adaptability to standard foundry techniques; i.e., core blowing and hand ramming. Temperatures in the curing and firing cycles do not exceed 960°C, and no vacuum firing is required. (auth)

39855 (EURAEC-848) FABRICATION OF SWAGED FUEL ELEMENTS. P. Himmelstein, F. Hofmann, W. Hoppe, H. Kroll, B. Liebmann, and O. Neumann (Nuklear-Chemie und -Metallurgie G.m.b.H., Wolfgang bei Hanau am Main, Germany). 1964. Work Performed under United States–Euratom Joint Research and Development Program. Contract 062-61-7-RDD. 104p. (EUR-541.d)

An improved hydrogen-arc furnace with tungsten electrodes, working on the arc-atom principle, was tested. It enables a production of 1 kg of fused UO_2 per hour, with a yield of 50%. The fused UO_2 contains less than 50 ppm W, the O/U ratio being between 1.97 and 2.01. A new melting technique, based on passing an electric current through the UO_2, was tested in a furnace with vertically arranged electrodes. Preliminary results give a yield higher than that of the hydrogen furnace as well as a powder with good vibration and swaging characteristics. The carbon content of the fused UO_2 is lower than 100 ppm and the O/U ratio is about 2.05. Vibration tests were carried out with an electromagnetic vibrator. Binary and ternary grain mixtures of hydrogen-arc molten UO_2 were compacted up to 85% t.d. UO_2 melted by the new method was compacted up to 87%, with a very slight powder recycle. Swaging tests were carried out with a two-die and a four-die machine. UO_2 melted in the hydrogen-arc furnace was cold swaged with a good reproducibility up to densities of about 93% t.d. with cross-section reductions of about 30%. When swaging at 750°C, densities of about 92% were attained with overall reduction of 30%. After hot swaging, the tube surface deteriorated due to the formation of oxide and spiral-shaped grooves. First swaging tests on UO_2 melted by a-c melting technique resulted in densities between 91 and 92% after a cold reduction of about 18%. Measurements showed that the thermal conductivity of swaged UO_2 is only 25 to 40% of that of sintered pellets. (auth)

39856 (EURAEC-1021) BASIC STUDY OF A FEW EMBRITTLEMENT FORMS AFFECTING JOINTS WELDED ON HIGH-RESISTANCE STEEL. Quarterly Report No. 8, October 1–December 31, 1963. (Société Anonyme des Forges et Ateliers du Creusot, Le Creusot, France). Jan. 1964. Work Performed under United States–Euratom Joint Research and Development Program. Contract 073-61-12-RDF. 11p.

The effects of fabrication techniques and weld composition on the ductility of the welded steel joints are summarized. (N.W.R.)

39857 (EURAEC-1107) METHODS FOR MANUFACTURING PRESSURE VESSELS. Quarterly Report No. 10, April 1–June 30, 1964. C. J. Verzijlbergh, W. P. van den Blink, and J. W. Velzeboer (Neratoom, N. V., The Hague). July 2, 1964. Work Performed under United States–Euratom Joint Research and Development Program. Contract 069-61-12-RD N. 5p.

Analysis is given of the weld metal which was welded by submerged arc welding by the automatic tandem welder with 40C wire and UM 90 powder. (auth)

39858 (EURAEC-1117) C.T.S. TESTS. INFLUENCE OF DEPOSITED METAL PHASE TRANSFORMATION TEMPERATURES ON CRACKING. Special Report No. 21, October 1–December 31, 1963. (Société Anonyme des Forges et Ateliers du Creusot, Le Creusot, France). Work Performed under United States–Euratom Joint Research and Development Program. Contract 073-61-12-RDF. 12p.

Sub-bead cracking is linked to the embrittling effect of hydrogen at the time of rapid transformations occurring

during welding. Hydrogen is generally carried by the welding products and its evolution in the basic metal is connected with the chronology of the phase transformations in the basic metal and the deposited metal. These transformations are linked to the composition of the metals present and to the cooling rates. (N.W.R.)

39859 (IITRI-B244-18) FINAL REPORT ON DEVELOPMENT OF IMPROVED LINER FOR EXTRUSION BILLET CONTAINERS. S. A. Spachner (Illinois Inst. of Tech., Chicago. IIT Research Inst.). May 1964. Contract AF33(657)-8784. 144p. (ML-TDR-64-194)

A program was carried out to secure an improvement of extrusion container liner performance and life for metal extrusion effected at 2000 to 3400°F. Liner-support tooling was developed to permit use of superalloy, ceramic-coated tool steel, and solid ceramics as liner materials capable of withstanding 180,000 psi stem pressure. The tooling utilized liner-sleeve assemblies which were not shrink-fitted in the container and could quickly be interchanged. The liner-sleeve assemblies therefore, were shrink-fitted and semiautomatically assembled by a machine developed for the purpose. Disassembly was accomplished by use of other specially developed tooling. Liner wall thickness was held to $\frac{1}{4}$ in. in all cases, effecting a considerable cost reduction in these parts. Prototype extrusion liners of René 41 and Udimet 700 superalloys, and a variety of both Rokide-process and plasma-arc-ceramic coated liners, were produced and evaluated by extrusion of 3 to $\frac{1}{2}$-in.-dia. SAE 4340 steel billets at 2000°F and extrusion of TZM alloy billets at 3300 to 3600°F, using a 1000-ton capacity, high-speed hydraulic press. Compositions of fiber-metal reinforced ceramic materials, specially designed for liner application, were produced and evaluated by extrusion-screening tests. A Rokide-process stabilized zirconia-coated liner withstood TZM alloy extrusion at 3450°F. Plasma-arc coatings of stabilized zirconia, and gradated alumina-nickel, and cast Udimet 700 alloy, proved satisfactory for steel extrusion at 2000°F. Preliminary evaluation indicated that glass lubricants were unnecessary when extruding steel billets in a gradated Al_2O_3–Ni ceramic coated extrusion liner. Fiber metal reinforced ceramic mixtures of $72Al_2O_3-28$Mo and $59.5Al_2O_3-40.5$Mo proved capable of withstanding billet temperatures of 3450°F. (auth)

39860 (NYO-10216) DEVELOPMENT OF VIBRATORY COMPACTION TECHNIQUES FOR RADIOACTIVE SOURCE FABRICATION. Gerald R. Armstrong and William A. Greenhow (General Scientific Corp., Washington, D. C.). Dec. 1962. Contract AT(30-1)-2981. 76p.

Work was performed to demonstrate the potentiality of using vibratory compaction as a means of fabricating radioactive source rods. This work included the design and fabrication of a vibratory compaction machine, and the experimental packing of cerium oxide and strontium titanate particles. Packing efficiencies achieved for these two materials were 80% and 85%, respectively. These are not optimum packing efficiencies since the experimental work did not include the determination of particle size combinations required for maximum density, or packing efficiency. The results do indicate that this method could be utilized for packing the radioactive material studied into source containers with associated densities greater than 90% of theoretical density. (auth)

39861 (WADD-TR-61-72(Vol.XXXIII)) RESEARCH AND DEVELOPMENT ON ADVANCED GRAPHITE MATERIALS. VOLUME XXXIII. INVESTIGATION OF HOT-WORKED RECRYSTALLIZED GRAPHITES. J. H. Turner and M. B. Carter (Union Carbide Corp. Carbon Products Div. Advanced Materials Lab., Lawrenceburg, Tenn.). Dec. 1963. Contract AF33(616)-6915. 69p.

Fabrication and testing of hot-pressed (ZT) graphites made from several base stocks was carried out. Physical properties, with emphasis on porosimetry, are reported for varieties of molded and pressure-cured graphites both before and after hot pressing. A small amount of work was also done with hot pressing of extruded graphites, powders, composites, and the surfaces of formed articles. The latter process is termed surface densification. (auth)

39862 (EURAEC-1007) WELDING OF VERY THICK STEELS. Quarterly Report No. 10, January 1–March 31, 1964. (Ghent. Rijksuniversiteit and Soudometal, S. A., Brussels). Work Performed under United States–Euratom Joint Research and Development Program. Contract 042-61-9 RDB. 126p. (A translation)

Studies are reported of: the production of local embrittlement by automatic welding; arrest temperatures in basic steels; the determination of arrest temperatures in the transformation zones of welded joints; statistical scatter in measurements of the arrest temperature; and the threshold for recrystallization appearance in joints welded by various processes and procedures. (T.F.H.)

39863 (EURAEC-1118) INFLUENCE OF WORK HARDENING IN THE VICINITY OF POINTS AC_1 AND AC_3 DURING WELDING CYCLES (RPI MACHINE). Special Report No. 22, September 1–December 31, 1963. (Société Anonyme des Forges et Ateliers du Creusot, Le Creusot, France). Jan. 1964. Work Performed under United States–Euratom Joint Research and Development Program. Contract 073-61-12 RDF. 18p. (A translation)

The effects of hot work-hardening on the ductility of the metal around the edge of the weld are studied in the welding of steel. Low hot work-hardening up to 5% does not seem to have a very serious influence on the impact strength; it may nevertheless be estimated that there is a slight tendency for the transition temperature to rise. (N.W.R.)

39864 JOINING CERAMICS TO METALS FOR HIGH TEMPERATURE SERVICE. Stanley W. Porembka, Jr. Battelle Tech. Rev., 13: No. 9, 2-7(Sept. 1964).

Methods in use and being developed for joining ceramics to metals are discussed along with some theories of joining mechanism. Basic considerations for joining, methods of testing, and applications are also considered. (M.C.G.)

39865 INVESTIGATIONS ON THE INFLUENCE OF POWDER QUALITIES ON THE SINTERING OF URANIUM DIOXIDE. W. Ermischer, H. Scheibe, and K. Winter (Zentralinstitut für Kernforschung, Rossendorf, Ger.). Kernenergie, 7: 412-19(June-July 1964). (In German)

The powder characteristics of various uranium dioxide batches, prepared by precipitation from uranyl nitrate solution with urea, from ammonium diuranate prepared by precipitation from uranyl nitrate solution with ammonia, and from uranium oxalate prepared by precipitation from uranium salt solutions with oxalic acid, respectively, were investigated and correlated with sinterability performance. Criteria corresponding to superior sinterability were established and methods for improving sinterability are discussed. It was found that if the tap density and the specific surface of a given material of UO_2 are known reliable information about its sintering behavior could be obtained. A

technique is described for improving the sintering behavior of uranium dioxide powder if the latter were subjected to reduction-oxidation treatment. (M.C.G.)

39866 THE SINTERING BEHAVIOR OF U_3Si_2 IN THE PRESENCE OF IRON. H. Steinkopff (Zentralinstitut für Kernforschung, Rossendorf, Ger.). Kernenergie, 7: 427-33(June-July 1964). (In German)

The sintering behavior of U_3Si_2, prepared by co-melting uranium and silicon under high vacuum at 1550°C and pulverizing the product in benzene with 2% paraffin oil, was investigated in the presence of 0 to 12% iron. Phase diagrams and 13 photomicrographs are presented for various three-component compositions. A liquid phase was noted under certain conditions; the composition of this phase was thought to be UFeSi. The structure of this composition, as determined by monocrystals randomly occurring in the liquid, is discussed. (auth)

39867 MACHINING GRAPHITE COMPONENTS FOR THE TRAWSFYNYDD NUCLEAR POWER STATION. S. C. Poulsen. Machinery (Engl.), 104: 1136-44(May 20, 1964).

Methods used in the machining of graphite components, such as core blocks, end-features, fillet radii, cruciform keys, and the core tiles, for the Trawsfynydd nuclear power station are discussed. The clean conditions used, machine-line layout, trepan boring, and broaching are also discussed. A diagrammatic layout of the clean conditions nuclear graphite machine shop, showing the arrangement of the lines devoted to core blocks, reflector blocks, and core tiles, is given. With the exception of two trepanning machines, none of the equipment is attached to the floor, to facilitate rearrangement of the line with minimum delay. (P.C.H.)

39868 CONSOLIDATING METAL POWDERS MAGNETICALLY. Donald J. Sandstrom (Los Alamos Scientific Lab., N. Mex.). Metal Progr., 86: No. 3, 91-4(Sept. 1964). (LADC-6442)

A technique was devised for consolidating refractory metal powders into tubular shapes by using the opposing magnetic fields in a coaxial conductor. Tubes of W, Mo, W + UO_2, and Mo + UO_2 powders have been compacted without need for binders in the powders. Also, it is possible to compact extremely long lengths at one time with a very uniform pulse and produce intricate shapes by varying mandrel geometry. In every instance, green density and strength of the as-compacted tubes were high enough to allow them to be handled with ease even before sintering. Densities approaching 100% of theoretical are reached with peak pressures above 50,000 psi. (P.C.H.)

39869 A COINING TECHNIQUE FOR THE FABRICATION OF MEDIUM-VOLUME CERMET NUCLEAR FUELS. Lawrence H. Cope (United Kingdom Atomic Energy Authority, Risley, Lancs, Eng.). Metallurgia, 70: 59-63(Aug. 1964).

In order to improve the quality of cermet fuel materials a simple fabrication process was devised that gives consistent high and controllable densities with little or no damage to the ceramic phase. Cermet bodies are cold-pressed for ceramic granules coated with metal powder; after sintering, these are densified by a series of coining operations with intermediate annealings. Annealing removes the residual work-hardening after coining, and renders the material amenable to further plastic deformation. Three or four coining operations suffice to raise the density from 80% (at the green pressing stage) to 97% of the maximum attainable. Since the forces brought to bear on a material during these coining operations are mainly compressive, and because the amount of deformation is limited to that necessary to close the metal matrix voids, the ceramic phase withstands the fabrication process without fragmentation or deformation, and with the minimum effect on its distribution within the matrix, as compared with alternative fabrication processes. (P.C.H.)

39870 VACUUM INDUCTION CASTING OF BERYLLIUM. J. L. Frankeny. Mod. Castings, 45: 348-52(June 1964). (RFP-340)

The technique for vacuum induction casting of large rectangular and cylindrical Be ingots by the bottom pouring method, utilizing scrap hot pressed material, machine chips, and Be-containing skulls is described. Coated graphite crucibles are preheated with careful temperature control and the melt heated to 1400 to 1450°C and held for outgassing and vaporization of Mg and Al. The melt is poured at 1325 to 1350°C. (Rev. Metal Lit., 21: No. 7, July 1964)

39871 THE DEVELOPMENT OF SPHERICAL PYROLYTIC-CARBON-COATED UC_2 AND $UThC_2$ FUEL PARTICLES. H. G. Sowman, R. L. Surver, and J. R. Johnson (Minnesota Mining and Mfg. Co., St. Paul). Nucl. Sci. Eng., 20: 227-34(Oct. 1964).

Spherical particles of UC_2 and $UThC_2$ were prepared by melting granules containing uranium and/or thorium as the oxide or other compound forms suspended in an isolating medium such as carbon. Microstructures of the UC_2 particles were varied from fine-grained polygranular to single-grained particles by controlled heating and cooling. Pyrolytic carbon coatings were applied by the use of several particle-agitating systems and the pyrolytic decomposition of hydrocarbon gases. A variety of structures were obtained depending on temperature, rate of deposition, and packing and motion of the agitated particles. (auth)

39872 THE EFFECT OF POROSITY ON THE REFINING OF REFRACTORY METALS DURING HIGH-TEMPERATURE SINTERING AND VACUUM-PREPARATION. G. P. Shveikin. Soviet Powder Met. Metal Ceram. (English Transl.), No. 3, 186-9(May-June 1963).

The conditions of impurity removal from refractory metals during sintering of their powders were examined. It is shown that in addition to the diffusion of elements in metals, their gaseous diffusion through the pores also takes place. (Rev. Metal Lit., 21: No. 7, July 1964)

39873 SINTERING OF MOLYBDENUM PRESSING IN MOIST HYDROGEN AND THEIR ROLLING INTO STRIP. E. P. Ignashev and A. U. Kharin. Soviet Powder Met. Metal Ceram. (English Transl.), No. 3, 248-51(May-June 1963).

Description is given of a method for the production of Mo powder from ammonium molybdate or MoO_3. The powders are pressed into billets and then sintered in moist hydrogen atmosphere at 1100 and 1700°C. It is indicated that the billets produced are suitable for rolling without the use of high-temperature welding. Data are tabulated for the properties of loose Mo powder and for the billets. (Rev. Metal Lit., 21: No. 7, 1964)

39874 BRAZING OF COLUMBIUM D36 HONEYCOMB STRUCTURES. A. H. Freedman and E. B. Mikus (Northrop Norair, Hawthorne, Calif.). Welding J. (N. Y.), 43: 385s-92s(Sept. 1964).

Brazing alloys and procedures were established for quartz lamp brazing thin gage niobium D36 (Nb–10Ti–5Zr) honeycomb structures. Honeycomb sandwich panels for

structural as well as heat shield applications were considered. Service temperature goals were 2500°F maximum for structural panels and 2700°F minimum for heat shield panels. Braze alloys investigated for structural panels included: (1) several alloys in the Ti–Cr–V ternary system and two Ti–Cr binary alloys. Braze alloys evaluated for heat shield applications included: pure titanium, Ti–13V–11Cr–3Al, Ti–30V, and V–20Ti. Suitability of braze alloys was based upon such factors as brazing temperature, filleting, flow and interaction behavior, high-temperature joint strength, long-time thermal stability with the base alloy, and compatibility with available protective coatings for niobium alloys. Final braze alloys selected were the Ti–33Cr alloy for the structural panels and the Ti–13V–11Cr–3Al for the heat shields. Procedures were established for making the Ti–33Cr braze alloy by a vacuum deposition of Cr on 0.0015-in. thick pure titanium foil. Homogenization of the foil was accomplished by a short diffusion treatment incorporated into the braze cycle. This process permitted use of this braze alloy in foil form. The Ti–33Cr and Ti–13V–11Cr–3Al braze alloys were evaluated for compatibility with two oxidation protection coatings. Cyclic oxidation tests at 2350 and 2500°F were performed in still air. (auth)

39875 METALLURGICAL BONDING OF PLASMA SPRAYED TUNGSTEN ON HOT MOLYBDENUM SUBSTRATES. W. A. Spitzig and S. J. Grisaffe (Lewis Research Center, Cleveland). Welding J. (N. Y.), 43: 425s-7s(Sept. 1964).

Metallurgically bonded plasma-sprayed tungsten was applied on metallographically polished and preheated molybdenum substrates. The substrates were preheated to 1750°F or higher immediately before spraying. The preheating and spraying operation was performed in a nitrogen atmosphere. Metallurgical bonding occurred when the preheated substrate temperature ranged between 2200 and 3700°F. At these temperatures the molybdenum substrates completely recrystallized even though the total time for preheating, spraying, and cool down to 400°F was only about 30 sec. Cross sections of the coating and substrate indicated that the coating-to-substrate bond is the result of substrate grains growing into the coating. (auth)

39876 NUCLEAR METALLURGY (VOL. IV). A SYMPOSIUM ON URANIUM AND URANIUM DIOXIDE, IMD FALL MEETING, CHICAGO, NOVEMBER 6, 1957. IMD Special Report Series No. 4. Am. Inst. Mining, Met. Petrol. Engrs., Inst. Metals Div., Spec. Rept. Ser., No. 4, 1-143(1957). New York, American Inst. of Mining, Metallurgical, and Petroleum Engineers, 1957. $7.00.

Sixteen articles are included on: casting, melting, forging, rolling, extrusion, cold working, fusion welding, and powder metallurgy of uranium and uranium alloys; uranium ingot production; melting and casting of Nb and Zr alloys; preparation of UO_2 for fuel element use; fabrication of bulk form UO_2 for use as nuclear fuel; and fabrication of high-density UO_2 fuel components for pressurized water reactor core. (P.C.H.)

39877 EXTRUSION PRESS, 280 TON (Engineering Materials). (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). (CAPE-1125)

Drawings (20) are presented for an extrusion press used in the fabrication of aluminum–plutonium spike enrichment fuel elements. As-cast billets are hot extruded at a 27 to 1 reduction using flat face shear dies and a colloidal suspension of graphite in oil as the die and container lubricant. Extrusion temperature is 525°C; ram speed is 20 in. per minute while extruding the 200 in. cores. An excellent surface is obtained on 0.502 in. dia cores. The press is enclosed in a glove box. For a listing of individual titles, see the Engineering Materials List (TID-4100). (C.E.S.)

Properties and Structure

Refer also to abstract 39058.

39878 (AAEC/TM-246) THE EFFECT OF TEMPERATURE ON THE MODULUS OF RUPTURE OF EXTRUDED AND SINTERED BeO IN THE RANGE 20–1000°C. K. Veevers and W. B. Rotsey (Australia. Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales). May 1964. 11p.

Extruded and sintered UOX grade BeO fabricated at Lucas Heights was tested to determine the strength–temperature relationship. The specimens, which were tested in the as-sintered condition, were 94.7 to 95.3% dense, had an average grain size of 4μ, and a surface layer of 13μ grains to a depth of 130μ. It was found that the modulus of rupture, in psi, at 20 to 1000°C could be expressed as: $\sigma_f = 33{,}000 + 3.1\ T - 0.0105\ T^2$. The 95% confidence limits were ± 8,295 psi and the within-batch variation was much greater than the between-batch variation. (auth)

39879 (AAEC/TM-251) GRAIN SIZE STABILITY OF FINE-GRAINED BERYLLIUM OXIDE. M. J. Bannister (Australia. Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales). May 1964. 9p.

Cold-pressed and sintered BeO specimens of grain size 3 microns and density 2.9 g/cm^3 did not change in grain size or density after heating in vacuum for 1000 hours at 1000°C. This result agrees with predictions based on grain growth and densification equations found for similar BeO at higher temperatures. Possible effects of neutron irradiation on grain growth are discussed, and it is concluded that there is a need for the study of grain growth in BeO under the combined influence of elevated temperature and neutron irradiation. (auth)

39880 (AD-600760) THE STRUCTURE OF GRAPHITIC MATERIALS–4. Final Technical Report, October 1, 1963–February 29, 1964. W. K. Armitage (Aeon Lab., Egham, Surrey, England). Mar. 17, 1964. Contract DA-91-591-EUC-1851. 40p.

The report discusses electron microscopic observations on synthetic graphite materials in both the ungraphitized and graphitized forms (heated at 2500°C) after various heat treatments and high temperature creep deformations. Moire fringe effects were reconciled with a turbostratic structure in which grains of graphite are subdivided into stacks of crystallites which are narrow in their c-direction and have small angular rotations in their respective basal planes. Electron diffraction patterns from this structure showed ring effects when the layer structure was normal to the electron beam, and elliptical effects when the beam was not normal to the layers. As the heat treatment temperature is raised, the diffraction rings or ellipses become progressively spotty as the crystallites grow and minimize their misorientation in the basal planes, until finally, after heat treatment at 2850°C, single crystal spot patterns are observed indicating that either the misorientations almost disappeared or the crystallite size increased greatly. (OTS)

39881 (AD-603473) X-RAY STUDY OF DEFORMATION OF Nb–Re ALLOYS. Technical Report No. 9. E. N.

Aqua and C. N. J. Wagner (Yale Univ., New Haven. Hammond Metallurgical Lab.). Apr. 1964. Contract NONR-609(43). 23p.

The bcc alloys of the terminal solid solution of rhenium in niobium were investigated by x-ray diffraction methods, supplemented by microhardness measurements. The hardness was found to increase almost linearly with rhenium percentages. The analysis of the broadening of the powder pattern peaks from the Nb-rich alloys, cold worked by filing, showed evidence for stacking faults and/or twin faults. The alloys with larger rhenium concentrations were brittle, and fractured when attempting to file. The analysis of the shapes of the diffraction profiles from powders of these brittle alloys (produced by hammering with steel plates) indicated that the broadening was due predominantly to platelets bounded by cube planes. This result was consistent with the data from (1) integrated intensity measurements and (2) Laue patterns from single cleavage facets which showed evidence for cleavage fracture on {100} planes. (auth)

39882 (AEET/CD/22) GRAIN BOUNDARY AND LATTICE DIFFUSION OF CHROMIUM IN ZIRCONIUM. R. P. Agarwala, S. P. Murarka, and M. S. Anand (India. Atomic Energy Establishment, Trombay). 1964. 19p.

Diffusion of chromium in grain boundaries and in alpha and beta phases of zirconium has been studied using radioactive tracer and residual activity technique. The diffusivities (in units of cm^2/sec) have been expressed as $D_{Cr/Zr}$ (gb) = 1.498×10^{-5} exp (−11,950/RT), $D_{Cr/ZR}$ (α) = 1.193×10^{-6} exp (−18,000/RT), and $D_{Cr/Zr}$ (β) = 3.850×10^{-2} exp (−41,000/RT). Results have been compared with other diffusion studies in zirconium and stronger bonding between chromium and zirconium in solid solution of zirconium is suggested. (auth)

39883 (AFCRL-64-199) THE VARIATION OF PERIODICITY OF MAGNETIC STRUCTURE WITH DILUTION AND TEMPERATURE FOR THE HEAVY RARE-EARTH METALS. Scientific Report No. 1 (Series 3). Bernard R. Cooper (Harvard Univ., Cambridge, Mass. Cruft Lab.). Feb. 24, 1964. Contract AF19(628)-3874. 11p. (AD-600772)

A discussion is given of the several possible mechanisms proposed to account for the variation of periodicity of magnetic order for the heavy rare earths. The relations between the thermal variation of periodicity for a given metal and the variation of periodicity among the various metals at the ordering temperature are considered. Emphasis is put on the importance of the neutron diffraction experiments on alloys of heavy rare earths diluted with Y for understanding the mechanism causing the periodicity variation. The type of interaction that seems most reasonable in fitting the various experimental evidence is suggested. (auth)

39884 (ANL-6435) THE U–Pu–C TERNARY PHASE DIAGRAM BELOW 50 ATOMIC PERCENT CARBON. Final Report of Metallurgy Program 9.3.8. S. Rosen, M. N. Nevitt, and A. W. Mitchell (Argonne National Lab., Ill.). Mar. 1964. Contract W-31-109-eng-38. 107p.

The U–Pu–C ternary phase diagram for the composition range from 0 to 50 at. % C and for temperatures below 635°C was constructed from metallographic, x-ray-diffraction, and melting-range data. Isothermal sections at 400, 570, and 635°C are presented, and certain four-phase reactions are outlined. (auth)

39885 (ASD-TDR-62-509(Vol.V)) BERYLLIUM RESEARCH AND DEVELOPMENT PROGRAM. METALLURGICAL FACTORS AFFECTING THE DUCTILE-BRITTLE TRANSITION IN BERYLLIUM. M. I. Jacobson (Lockheed Missiles & Space Co., Palo Alto, Calif.). Oct. 1963. For Nuclear Metals, Inc., West Concord, Mass. Contract AF33(616)-7065. 83p.

An investigation was made of the factors controlling the ductile-brittle behavior of two grades of commercial purity beryllium, Brush QMV and Pechiney CR. Tensile tests were made on randomly oriented samples at temperatures from 23°C to 500°C. Extrusions were tested in the longitudinal and transverse directions in the range −195°C to 200°C. Three grain sizes of each material were investigated, and comparisons made between specimens tested in the aged and unaged condition. The aging treatment was 900°C for 6 hours followed by 48 hours at 700°C. Mechanical properties of both materials were very similar after this heat treatment and no advantage could be claimed for the higher purity Pechiney beryllium. Aging reduced the amount of impurities in solid solution and contributed to improved ductility in certain temperature ranges. In general, the transition temperature was lower; the smaller the grain size, the slower the strain rate, and the purer the material. Lower transition temperatures were observed for the longitudinal and transverse directions of the extrusions than for the hot-pressed, randomly oriented specimens. The ductile-brittle transition could not be described in terms of the dislocation pileup theories for body-centered-cubic metals. A theory of the ductile-brittle transition based on the thermally activated cross slip of screw dislocations from the basal plane into pyramidal or prismatic planes was proposed. The data could be described reasonably well in terms of this theory. (auth)

39886 (AWRE-O-36/64) THE EQUATION OF STATE OF COPPER AND OF OTHER METALS NEAR THEIR CRITICAL POINTS. E. Morris (United Kingdom Atomic Energy Authority. Weapons Group. Atomic Weapons Research Establishment, Aldermaston, Berks, England). July 1964. 48p.

A method is developed for finding a relationship between the pressure, specific internal energy, and density of metals for a range of these thermodynamics variables enclosing the critical point. A relation of the Grüneison form, $p = \rho\gamma(\rho)[\epsilon - \epsilon_0(\rho)]$ is assumed and values of the two parameters in this equation are given for copper for densities between 10 and 0.1 g/cc. A method of describing the partially vaporized metal is given. (auth)

39887 (BM-RI-6503) THE CHROMIUM–GADOLINIUM SYSTEM. Mark I. Copeland, C. E. Armantrout, and H. Kato (Bureau of Mines. Albany Metallurgy Research Center, Ore.). Jan. 1964. 11p.

The data collected during this investigation indicate that the chromium–gadolinium system has extensive liquid immiscibility and one eutectic point. Liquid immiscibility occurred at temperatures above the monotectic isotherm, 1,830°C, which extended from less than 0.25 to about 85 weight-percent gadolinium. The eutectic was at 96 percent gadolinium and 1,170°C. Gadolinium and chromium were the only phases in this system. There was a solid solubility of less than 0.25 percent gadolinium in chromium at 1,730°C and less than 0.10 percent chromium in gadolinium at 1,160°C. The alloys were prepared by nonconsumable-electrode arc-melting, and the alloy system was investigated by heat treatment, metallography, thermal analysis, and x-ray diffraction. All the melting, heat treatments, and thermal analyses were conducted in a vacuum or in helium because of the reactivity of chro-

mium and gadolinium with the components present in the atmosphere at elevated temperatures. (auth)

39888 (BM-RI-6515) EFFECT OF URANIUM ON THE ISOTHERMAL TRANSFORMATION AND HARDENABILITY OF A LOW-ALLOY STEEL. K. A. Fowler and L. W. Higley, Jr. (Bureau of Mines. Rolla Metallurgy Research Center, Mo.). Jan. 1964. 20p.

The effect of uranium on the transformation kinetics and the hardenability of a low-alloy steel was evaluated. Isothermal transformation curves were developed from metallographic studies, and hardenability was determined by standard Jominy end-quench tests. For the steels investigated, the addition of 0.15 weight-percent uranium was found to produce a significant shift in the isothermal transformation curve and caused a related increase in hardenability. These effects diminished rapidly when the uranium content was increased above 0.2 weight-percent. (auth)

39889 (BM-RI-6518) HEATS OF FORMATION OF ZIRCONIUM CARBIDE AND HAFNIUM CARBIDE. Alla D. Mah (Bureau of Mines. Berkeley Thermodynamics Lab., Berkeley, Calif.). Apr. 1964. 10p.

The energies of combustion of ZrC and HfC were measured by combustion calorimetry and the heats of combustion and formation of these compounds were derived. The results for ZrC are $\Delta H_{298.15}$ (combustion) = −308.60 ± 0.55 kcal/mole, $\Delta H_{298.15}$ (formation) = −47.0 ± 0.6 kcal/mole, and for HfC $\Delta H_{298.15}$ (combustion) = −306.08 ± 0.20 kcal/mole, $\Delta H_{298.15}$ (formation) = −52.3 ± 0.4 kcal/mole. (auth)

39890 (BM-RI-6521) THE HAFNIUM–TANTALUM EQUILIBRIUM DIAGRAM. Laurance L. Oden, D. K. Deardorff, M. I. Copeland, and H. Kato (Bureau of Mines. Albany Metallurgy Research Center, Ore.). Feb. 1964. 15p.

The equilibrium relationship of hafnium and tantalum was studied to facilitate alloy and property investigations. The data obtained are presented graphically as the equilibrium diagram. Alloys were prepared from high-purity components by nonconsumable-tungsten-electrode arc melting. Data for the equilibrium diagram were obtained by optical pyrometry, metallography, x-ray diffraction of heat treated specimens, x-ray diffraction using a high-temperature camera, and differential thermal analysis. During the investigations, a casting apparatus was constructed, and the existing melting-point apparatus was improved. The bcc allotrope of hafnium forms a continuous series of solid solutions, called beta, with tantalum which exhibits a minimum melting point at 20 wt pct tantalum and 2,110°C. At 24 wt pct tantalum and 1,050°C, hafnium-rich beta decomposes in a monotectoid reaction to yield alpha and tantalum-rich beta. The monotectoid isotherm extends from 5.5 to 60 wt pct tantalum. The two-phase region, in which hafnium-rich and tantalum-rich beta solid solutions are immiscible, rises to a maximum temperature of 1,265°C at 38 wt pct tantalum. The solubility of hafnium in tantalum decreases from 40 wt pct at the monotectoid temperature to 20 wt pct at 750°C. (auth)

39891 (BMI-1673) EFFECT OF 5 a/o TANTALUM ON THE UC–UC_2 SYSTEM. Walston Chubb and Donald L. Keller (Battelle Memorial Inst., Columbus, Ohio). July 13, 1964. Contract W-7405-eng-92. 12p.

The structures of a series of castings containing 5 at. % tantalum, 45 to 65 at. % carbon, balance uranium were analyzed in terms of their implications with regard to the nature of the uranium–carbon–tantalum system at the liquidus temperature. The minimum in the liquidus between UC and UC_2 apparently develops into a ternary eutecticlike trough which passes through a minimum temperature at a composition containing a negligible amount of tantalum, 57 to 59 at. % carbon, balance uranium. This trough proceeds on and passes through a point near 65 at. % carbon, 2 to 3 at. % tantalum, balance uranium. (auth)

39892 (BMI-1685) CONSTITUTION OF THE SYSTEMS OF URANIUM AND CARBON WITH MOLYBDENUM, NIOBIUM, RHENIUM, TUNGSTEN, AND YTTRIUM. Walston Chubb and Donald L. Keller (Battelle Memorial Inst., Columbus, Ohio). Aug. 11, 1964. Contract W-7405-eng-92. 41p.

The U–C–Mo system was found to contain only one ternary phase, $UMoC_2$, possessing a range of homogeneity from 46 to 50 at.% C. A pseudobinary tie line exists between UC and Mo below 1800°C. Between 1800 and 1900°C, UC and Mo react peritectically to form U liquid and $UMoC_2$. Pseudobinary systems also exist between $UMoC_2$ and UC, graphite, Mo_2C, and Mo. Nb_2C and NbC in intimate contact with liquid U at 1540°C contained less than 1 at.% U; the U contained no detectable Nb. The UC–NbC solid solution does not contain less than 49 at.% C at any composition containing more than 1 at.% U. The NbC corner of the NbC–Nb_2C–U region lies near 45 at.% C, 54 at. % Nb, and less than 1 at. % U. The U–C–Re system contains a ternary phase, $UReC_2$. Pseudobinary tie lines extend from UC to URe_2, from UC to Re, and from $UReC_2$ to Re. Like in the U–C–Mo system, psuedobinary tie lines exist in the U–C–W system at 1500°C between UC and W and between UWC_2 and all the phases in the system except U. At 1500°C, the Y–C system contains two intermediate phases, a peritectically formed face-centered-cubic phase, YC, containing about 40 at. % C and an equiaxed and presumably cubic dicarbide, YC_2, which transforms to a tetragonal structure below 1500°C. A complete series of solid solutions exists between UC and YC and, probably, between UC_2 and YC_2. The UC–YC solid solution contains less than 50 at. % C at compositions containing as little as 8 at. % Y. Y displaces U from the UC–YC solid solutions. (auth)

39893 (BMI-1686) CHEMICAL DIFFUSION IN UC_2 AND UC AND THERMAL DIFFUSION IN UC. Knut H. Osthagen and Arthur A. Bauer (Battelle Memorial Inst., Columbus, Ohio). Aug. 12, 1964. Contract W-7405-eng-92. 18p.

Chemical diffusitivies in UC_2 were determined at 1900, 2000, and 2050°C on the basis of layer-growth measurements in couples of UC plus UC_2 versus graphite. The diffusivities can be expressed by $D_{UC_2} = 0.082 \exp(-53{,}800/RT)$. Phase boundary limits used in the diffusion analysis were checked in diffusion couples prepared with ^{14}C. Estimates of diffusivities in UC were also made and values of 1.8×10^{-6} and 6.5×10^{-6} cm^2 per sec at 1900 and 2050°C, respectively, were obtained. Experiments were performed to study the conditions for thermal diffusion in UC. Within the limits of the experimental techniques, no evidence of thermal diffusion was detected in thermal-gradient specimens with maximum hot-end temperatures of 1900°C and temperature gradients of 500°C per cm after heating for times up to 93 hr. (auth)

39894 (EURAEC-1110) STUDY OF PHYSICAL PROPERTIES OF UO_2 AND UO_2–PuO_2. Final Report A. Test Report No. 380. H. E. Schmidt (France. Commissariat à l'Énergie Atomique. Centre d'Etudes Nucléaires, Fon-

tenay-aux-Roses). Apr. 1964. Work Performed under United States–Euratom Joint Research and Development Program. Contract 037-60-12-RDF. 41p.

Electric Specific Resistance. An investigation has been made into the influence which the method of preparing the powders, the compaction pressure, the sintering temperature, the density, and the oxygen content of the adjuvants (Nb_2O_5, ThO_2, and NaF) have on the electric properties of sintered UO_2 pellets. The logarithm of the resistance of UO_2 monocrystals is well a linear function of 1/T between room temperature and about 900°C. A slight change of slope at about 250°C may be ascribed to a phase shift. The addition of PuO_2 brings about a considerable increase of the electric resistance of sintered UO_2. The specific resistance variations of UO_2-PuO_2 with temperature seems to point to the fact that PuO_2 is a classical semiconductor which can be described by a strip model, contrary to UO_2 for which a conduction mechanism by polarons has been suggested. Contrary to UO_2, the influence of ThO_2 additions on the electric properties of UO_2 is quite small. Thermoelectric Power. Although no systematic study on the subject has been made yet, a few preliminary measurements indicate that an addition of about 0.4% of Nb_2O_5 causes a change of sign of the (absolute) Seebeck effect, from plus to minus. Hall Effect. The only result obtained with sintered UO_2 after a fairly close experimental investigation is that its Hall coefficient is less than 0.5 cm^3/amp. sec contrary to what had been observed previously. This result has been confirmed by the scientists working at Mol and explained by the fairly small degree of mobility of the charge bearers. Thermal Conductivity. A few measurements of the thermal conductivity of UO_2 were made at room temperature by applying the nonstationary Ångström method by means of which it is possible to determine the diffusion coefficient of the material by measuring the propagation velocity of the temperature changes along a cylindrical sample. Another apparatus, based on the same principle, and which makes it possible to effect measurements at temperatures above 2000°C, has been constructed. (auth)

39895 (GEMP-296) A RADIAL HEAT FLOW APPARATUS FOR HIGH-TEMPERATURE THERMAL CONDUCTIVITY MEASUREMENTS. A. D. Feith (General Electric Co. Advanced Technology Services, Cincinnati). Aug. 31, 1964. Contract AT(40-1)-2847. 25p.

A steady-state radial heat flow apparatus for measuring the thermal conductivity of solid materials at temperatures up to 2250°C is described. Thermal gradients were induced in a stack of 2-in.-dia. discs by means of a resistively heated tubular heater which passed through a hole in the center of the discs. Protective atmospheres of H_2, Ar, or He were employed depending upon the particular material under study. Temperatures were measured by a Pt/Pt–10Rh thermocouple up to 1200°C and by an optical pyrometer above this temperature. This technique was used to measure the thermal conductivity of $ZrO_2(CaO)$, 1000 to 2250°C; BeO, 650 to 2230°C; $UO_{2.2} \cdot 3Y_2O_3$, 745 to 1950°C; $ZrO_2(Y_2O_3)$ + Zr, 1000 to 2100°C; Y_2O_3, 1050 to 2230°C; UO_2, 550 to 2240°C; and $W-UO_2$, 950 to 2260°C. The results of the measurements of UO_2 and $W-UO_2$ are not included. (auth)

39896 (HW-82631) FRACTURE STUDIES OF ZIRCALOY-2. R. G. Hoagland and A. L. Bement, Jr. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). June 4, 1964. Contract AT(45-1)-1350. 29p.

Slow bend tests on fatigue cracked beams indicate that Zircaloy-2 undergoes a ductile-to-brittle transition at about −130°C(−202°F) in the annealed condition. Cold rolling to 23% reduction in thickness results in a 60°C(108°F) increase in the transition temperature, and a forty-fold increase in the crosshead speed of the testing machine causes a further increase of 30°C (54°F) in the transition temperature. Charpy impact tests indicate a transition temperature about 500°C (900°F) above the transition temperature for the fatigue cracked beams. However, Charpy specimens tested in slow bending undergo a transition about 100°C (180°F) below the fatigue cracked beams indicating the combined effects of crack sharpness and loading rates on the transition temperature. Of the three orientations examined in the annealed material, i.e., crack propagation parallel, transverse, and at 45° to the rolling direction, no distinct effect of anisotropy on the transition temperature was found. Fracture occurred with nearly the same ease in the parallel and transverse specimens, but was considerably more difficult for the 45° orientation. Optical metallography and electron microfractography were also performed. Optical micrographs indicate that the fracture mode is principally ductile both above and below the transition temperature with only small regions of cleavage occurring below the transition temperature. The electron microfractography further confirms this observation. The cleavage regions as seen in the electron microfractographs possess a hexagonal network of unknown origin. (auth)

39897 (IS-848) YTTRIUM–OXYGEN PHASE SYSTEM. R. C. Tucker, Jr., E. D. Gibson, and O. N. Carlson (Ames Lab., Ames, Iowa). [Mar. 1964]. Contract [W-7405-eng-82]. 22p. (CONF-506-4)

From Symposium on Compounds of Interest in Nuclear Reactor Technology, Boulder, Colo., Aug. 1964.

An equilibrium diagram is proposed for the yttrium–oxygen phase system based on metallographic observations, thermal analyses, thermo-resistance measurements, melting point determinations, and x-ray studies. The principle features of the diagram are a eutectic reaction at 1560°C, a eutectoid reaction at 1180°C, and a maximum in the solidus occurring at about 5.5 wt % oxygen. The eutectic and eutectoid compositions are estimated at 9.7 and 3.8 wt % oxygen respectively. The solubility of oxygen in α yttrium increases from less than 0.06 wt % at 600°C to 3.3 wt % at the eutectoid temperature while the maximum solubility in β yttrium is approximately 7.3 wt % oxygen at the eutectic temperature. The Y_2O_3-rich liquidus was determined experimentally. (auth)

39898 (IS-929) TENSILE TEST TO FIND ENDURANCE LIMIT OF STRAIN-AGEABLE METALS. Knud Pedersen and Glenn Murphy (Ames Lab., Ames, Iowa). July 1964. Contract W-7405-eng-82. 18p.

Fatigue curves for steel C-1118 were constructed for room temperature and 100°C from data collected from a number of fatigue tests. The endurance limit of the steel was estimated at the same temperatures from additional fatigue tests. Cyclic tensile tests were performed on several specimens at each of the two temperatures, with each specimen receiving many cycles of loading and unloading. The proportional limits obtained from the cyclic curves were averaged for each temperature. The value thus obtained for the proportional limit was compared with the endurance limit and there appears to be good agreement. (auth)

39899 (LA-2942) A CRITICAL REVIEW OF REFRACTORIES. Edmund K. Storms (Los Alamos Scientific Lab., N. Mex.). Mar. 1964. Contract W-7405-eng-36. 252p.

Supersedes LAMS-2674, Parts I and II.

The literature concerning the Group-4a, -5a and -6a carbides and nitrides, and the carbides and nitrides of Th, U, and Pu has been reviewed critically. The following properties have been discussed: preparation, phase relationship, lattice parameter and structure, appearance, chemical stability, hardness, resistivity, superconductivity, thermodynamic properties and vaporization. When possible, each property has been considered in light of the wide homogeneity range exhibited by these compounds. Particular attention has been paid to methods by which the materials can be made oxygen- and nitrogen-free. (auth)

39900 (LAMS-3092) STUDIES ON THE ALPHA-TO-BETA AND BETA-TO-ALPHA PHASE TRANSFORMATION OF PLUTONIUM. J. W. Anderson, W. J. Maraman, and P. D. Edwards (Los Alamos Scientific Lab., N. Mex.). June 1, 1964. Contract W-7405-eng-36. 57p.

The alpha-to-beta and beta-to-alpha phase transformations of plutonium were observed by measuring changes in electrical resistivity. Specimens of different thicknesses were heated from ambient temperature by immersion in agitated, constant-temperature baths. The bath temperature ranged from 123 to 200°C. These specimens were then cooled by immersion in baths at temperatures ranging from ambient to −196°C. A thermocouple was imbedded whenever possible in each specimen. The density of each specimen was determined before and after each run. The alpha-to-beta transformation is essentially completed in fractions of a minute after specimens at ambient conditions are immersed in baths preheated to 165°C. The beta-to-alpha transformation is essentially completed in less than 3 min after the immersion of thin specimens into baths at ambient temperature. The time required for these transformations is influenced by specimen purity, history and geometry, bath temperature and other factors. (auth)

39901 (NAA-SR-Memo-3848) THERMAL CONDUCTIVITY OF HYDRIDES OF Zr−U ALLOYS. D. L. Henry (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). May 7, 1959. Contract AT-11-1-GEN-8. 4p.

Results of limited thermal conductivity measurements on hydrides of Zr and Zr−U alloys are presented. (J.R.D.)

39902 (NAA-SR-Memo-9475) PIQUA MAIN HEAT TRANSFER SYSTEM COMPONENT ANALYSIS PROGRAM. J. J. Auleta, Jr. (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Jan. 28, 1964. Contract [AT(11-1)-Gen-8]. 42p.

Standard evaluation methods are presented for the routine performance checking of the main heat transfer pumps and the steam generator of the PNPF main heat transfer system. These methods will be used to detect changes in the efficiency of the centrifugal pumps, and in the overall heat transfer coefficient of the heat exchangers. A Fortran program for performing the calculations is presented. A routine surveillance of the performance of the main heat transfer system and its components is a means of obtaining warning of anomalies or malfunctions of this system. (auth)

39903 (NAA-SR-Memo-9844) HYDROGEN PERMEATION THROUGH METALS. R. W. Webb (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Apr. 27, 1964. Contract [AT(11-1)-Gen-8]. 12p.

A compilation of hydrogen permeation data through metals is presented. The metals which were considered were those which might be used in the SNAP reactor systems. The permeability of hydrogen through these metals must be known to predict hydrogen mobility and migration in the NaK primary system. Particular concern is for the amount of hydrogen which will migrate into the mercury loop. The flux of hydrogen gas permeating various metals was either determined experimentally or gathered from reports listed in the bibliography. The data were fitted to the following equation: $\phi = (CP^{1/2}/x) \exp(-Q/RT)$ where ϕ = flux (cc at STP/hr-cm^2), C = permeation constant [cc(STP)-mm/hr-cm^2-atm], P = hydrogen pressure (atmospheres), x = membrane thickness (mm), Q = activation energy (cal/mole), R = gas constant (cal/mole − °A), and T = absolute temperature. (auth)

39904 (NAA-SR-Memo-9905) LOW-TEMPERATURE HARDENING OF PH15-7 Mo STAINLESS STEEL. W. R. Kerr (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). May 7, 1964. Contract [AT(11-1)-Gen-8]. 24p.

Low temperature hardening of aged PH15-7 Mo stainless steel has been investigated in the range 500°F to 800°F. The low temperature hardness increases represent decreases in ductility and in strength but not according to a direct relationship. After exposure to temperature in the range 500°F to 800°F up to 5000 hours, material in the standard RH-950 aged condition maintains the best combination of tensile properties. (auth)

39905 (NP-14268) A NOTE ON THE THERMAL CYCLING OF ZIRCONIUM. J. F. Mellor (English Electric Co., Ltd., Whetstone, Leics, England). Sept. 14, 1960. 14p. (NPCC/FEWP/P.575)

The results of some thermal cycling experiments on unalloyed zirconium are presented, which show that large thermal cycling effects can be obtained in certain conditions. A tentative explanation of these results is made and their probable significance in current reactor application is noted. (auth)

39906 (NRL-6141) ELECTRON PROBE MICROANALYSIS OF THE DIFFUSION SYSTEMS β−TITANIUM−VANADIUM, β-TITANIUM−NIOBIUM, AND CHROMIUM−VANADIUM. R. E. Seebold (Naval Research Lab., Washington, D. C.). July 2, 1964. 6p.

The diffusions of niobium and vanadium into pure β-titanium at 1100°C have been studied. Concentration versus distance curves for these systems are similar to each other but are skewed and different in shape from the Gaussians expected in self-diffusion. At temperatures between 1050°C and 1200°C the curves for chromium-vanadium diffusion do approximate Gaussians. Diffusion coefficients for all three systems have been calculated by Matano's method at elemental concentrations from 5 at.% to 95 at.%. Logarithms of the diffusion coefficients D for β-titanium with both niobium and vanadium follow a reasonable straight-line relationship with the atom-percent of the solute element. The D values range from 3.5×10^{-12} cm^2/sec at 95 at.% Nb to 7.0×10^{-10} cm^2/sec at 5 at.% Nb, and from 4.5×10^{-11} cm^2/sec at 95 at.% V to 5.0×10^{-9} cm^2/sec at 5 at.% V. Calculated D values for Cr−V at 1050°C, 1100°C, and 1200°C are 4.5×10^{-14}, 1.3×10^{-13}, and 5.6×10^{-12} cm^2/sec respectively. A frequency factor, D_0, of 6 ± 4 cm^2/sec and an activation

energy, Q, of 71 ± 4 kcal/g atom were also calculated for Cr–V. (auth)

39907 (ORNL-3668) PHASE EQUILIBRIUM STUDIES IN THE SYSTEM UC_2–ThC_2. N. A. Hill and O. B. Cavin (Oak Ridge National Lab., Tenn.). Sept. 1964. Contract W-7405-eng-26. 21p.

The results of high-temperature x-ray diffraction coupled with differential thermal analysis, isothermal annealing, and the examination of structures at room temperature by metallography and x-ray powder patterns of a range of uranium dicarbide–thorium dicarbide arc-melted alloys have been used to identify the phases found and their areas of stability. A tentative equilibrium diagram section for these alloys in the presence of excess graphite has been constructed. At high temperatures, a single face-centered cubic phase was found at all compositions. On cooling to a temperature, depending on composition (1820°C for UC_2, 1420°C for ThC_2, and 1110°C for a 50/50 mixture), the alloys transformed to a low-temperature structure. From UC_2 to alloys containing 30 wt % ThC_2, the low-temperature structure was a single solid-solution phase having the UC_2 structure. From approximately 30 to 38 wt % ThC_2, there was a two-phase region with the UC_2 solid solution as one phase and a second phase whose diffraction pattern can be indexed most simply as body-centered tetragonal. This latter phase alone was found from approximately 40 to 70 wt % ThC_2, changing at higher ThC_2 compositions to the monoclinic ThC_2 solid solution which could contain up to approximately 20 wt % UC_2. However, from the powder x-ray data, it was not possible to determine if this was a discontinuous structure change, and no two-phase region could be found in the ThC_2-rich alloys. No major variation was found in melting temperature as a function of composition. (auth)

39908 (ORNL-RMIC-3) GROUPS IV, V, AND VI TRANSITION METALS. SELECTED REFERENCES ON PREPARATION, STRUCTURE, PHYSICAL PROPERTIES, METALLOGRAPHY, AND TRANSPORT PROPERTIES. (Oak Ridge National Lab., Tenn.). Sept. 1964. Contract [W-7405-eng-26]. 25p.

Approximately 400 references are presented under the following headings: preparation methods, crystal structure and phase transitions, transport properties, and physical and mechanical properties. (D.L.C.)

39909 (R64SD-26) MECHANICAL PROPERTIES OF PYROLYTIC GRAPHITE. J. J. Gebhardt and J. M. Berry (General Electric Co. Missile and Space Div., Valley Forge Space Technology Center, King of Prussia, Penna.). Apr. 1964. 37p. (AD-437144)

A series of mechanical strength and thermal expansion tests was carried out from room temperature to 5000°F on the two microstructural types of current production pyrolytic graphite. Results indicate that with appropriate precautions in selecting test material, machining, and testing specimens, current production pyrolytic graphites yield higher, more reliable mechanical property values. The contribution of process improvements to this increase cannot be specifically separated although it may show up principally in allowing more of a given batch of material to be selected. The present series of tests shows pyrolytic graphite to have an ultimate "a" direction tensile strength of 18,000 ± 2,000 psi at room temperature rather than previously found values of 11,000 ± 5,000 psi. The largest difference between surface nucleated and continuously nucleated material was obtained in torsional tests parallel to the planes; values of 1555 ± 60 and 2880 ± 265 psi were obtained respectively throughout the temperature range to 5000°F. (auth)

39910 (TID-21063) EFFECT OF HYDROSTATIC PRESSURE ON THE SELF-DIFFUSION RATE IN SINGLE CRYSTALS OF GOLD. R. H. Dickerson, R. C. Lowell, and C. T. Tomizuka (Arizona. Univ., Tucson). [1963]. Contract AT(11-1)-1041 and AF(638)-790. 41p.

Thesis submitted by R. H. Dickerson.

The rate of self-diffusion in Au was measured by the radioactive tracer-lathe sectioning technique at 860, 910, and 960°C and at hydrostatic pressures from 2.00 to 9.08 kilobars. The diffusion rate was observed to decrease with increased pressure, and the activation volume for self-diffusion was determined to be 7.2 ± 0.4 cm^3/mole. This value is in good agreement with the sum of the experimental values of the activation volumes of formation and motion in Au, the experimental values of the activation volumes in other fcc metals, and many of the theoretical values calculated for Cu. The value also is in fair to excellent agreement with the various expressions relating the activation volume to other experimentally derived quantities. The limiting source of error in pressure-diffusion experiments of this type was found to be in controlling the measurement, reproducibility, and uniformity of the temperature. (auth)

39911 (UCRL-7324) THE DIFFUSION OF NONVOLATILE METALLIC ELEMENTS IN GRAPHITE. J. R. Wolf, D. R. McKenzie, and R. J. Borg (California. Univ., Livermore. Lawrence Radiation Lab.). Apr. 29, 1964. Contract W-7405-eng-48. 62p.

The diffusion coefficients for Ag, Ni, U, Th, and Ra diffusing in various types of graphite have been determined as a function of temperature. Good precision is obtained in all cases and the corresponding activation energies are reported. These values, when comparison is possible, do not agree with values previously reported. An explanation is given for the discrepancy based upon the relative insolubility of metals in graphite. Experimental evidence is presented which indicates that substitutional, pore, and interstitial diffusion are negligible and that all mass transport proceeds via grain and subgrain boundaries. (auth)

39912 (UCRL-7869) THE PROPERTIES OF A METASTABLE GAMMA-PHASE URANIUM-BASE ALLOY: U–7.5 Nb–2.5 Zr. C. A. W. Peterson and R. R. Vandervoort (California. Univ., Livermore. Lawrence Radiation Lab.). May 13, 1964. Contract W-7405-eng-48. 36p.

The uranium–niobium–zirconium ternary system exhibits a series of solid solutions at high temperature. Addition of both niobium and zirconium stabilizes the body-centered-cubic gamma phase to a lower temperature. A study has been made of one particular ternary alloy, the U–7.5 wt % Nb–2.5 wt % Zr composition. The relationship of transformation characteristics of the alloy to its physical and mechanical properties has been determined. This weldable alloy is concluded to be an excellent material for engineering applications. Tensile yield strengths of 100,000 to 200,000 psi are obtainable, with elongations of 12% to 4%, respectively, depending on heat treatment. (auth)

39913 (UJV-930/63) ZUR FRAGE DER HERSTELLUNG VOM PULVERFORMINGEN NICHT PYROFORISCHEN URAN. (On the Question of the Production of the Powdered Nonpyrophoric Uranium). L. Jakešová and

J. Wolf (Československá Akademie Ved. Ustav Jaderného Výzkumu, Řež). 1964. 18p.

For preparation of the powdered uranium, the reduction of UO_2 by calcium hydride was used and the effects of the conditions of reduction (temperature, length of continuance of the reduction, concentration of $CaCl_2$ in the reaction mixture, and weight of the reaction mixture) on the particle size and granulometric composition of the originating uranium powder were investigated. In the region of the selected temperatures, 900 to 1100°C, these effects were established. The results are shown in graphs. (tr-auth)

39914 (WADD-TR-61-181(Pt.IV)) THE TENSILE DUCTILITY-TRANSITION IN MOLYBDENUM. B. S. Lement and K. Kreder (ManLabs, Inc., Cambridge, Mass.). July 1964. Contract AF33(657)-8424. 90p.

An investigation was carried out to determine the nature of the tensile ductility transition in recrystallized molybdenum strip of three interstitial contents. For a fine grain size, the tensile ductility transition temperature (T_d) and the brittleness transition temperature (T_b) were found to approximately coincide; whereas with increase in grain size T_d is raised and T_b is lowered. The occurrence of a minimum in the fracture stress (σ_F) at T_d appears to be associated with the temperature dependence of the necking stress (σ_n). Prestraining above T_d, was found to result in as much as a 20% increase in σ_F as determined at temperature below T_d. In general, the mode of fracture initiation was found to be intergranular at T_d or below and cleavage above T_d. For a test temperature above as well as below T_d, crack initiation appears to be the controlling step in fracture. Considering σ_F as a flow stress corresponding to the fracture strain (ϵ_F), the variation of σ_F with temperature above T_d was predicted within about 15%. Based on a modification of the Cottrell relation for crack initiation, the increase in σ_F above T_d is associated with a decrease in both the flow locking parameter (k_f) and the effective grain size. (auth)

39915 (EURAEC-1105) DIFFUSION OF NOBLE GASES IN SOLIDS. Quarterly Report No. 16, April–June 1964. (Hahn-Meitner-Institut fur Kernforschung, Berlin). July 1964. Work Performed under United States–Euratom Joint Research and Development Program. Contract 028-64-1TEE(R D). 13p. (EU-B33). (A translation)

Investigation was made of the diffusion of Xe in UO_2 monocrystal pellets with simultaneous evaporation. The evaporation kinetics were confirmed experimentally. A mathematical method based on these kinetics for separating the measured noble gas release into a diffusion-component and an evaporation-component was also tested out. With KCl monocrystals no measurable difference was observed above 400°C in the diffusion of ^{39}Ar ($t_{\frac{1}{2}}$: 265 yr) as compared with ^{41}Ar. (auth)

39916 (EURAEC-1119) RELATIONSHIPS BETWEEN THE AUSTENITIZATION CONDITIONS, AUSTENITIC GRAIN AND EMBRITTLEMENT IN QUENCHED STATE. Special Report No. 23, October 1–December 31, 1963. (Société Anonyme des Forges et Ateliers du Creusot, Le Creusot, France). Work Performed under United States–Euratom Joint Research and Development Program. Contract 073-61-12 RDF. 16p. (A translation)

Austenitization conditions for three steels (reference casting without refining elements and the castings with aluminum and niobium contents) are described. Results show that embrittlement is a function of the austenitic grain size. The effect peculiar to niobium is to increase embrittlement. Aluminum has no noticeable effect on embrittlement. Embrittlement depends primarily on the austenitization conditions. (N.W.R.)

39917 (EURAEC-1120) TO SHOW THE PRESENCE OF A PREMARTENSITIC AREA IN THE ESTABLISHMENT OF AN ANISOTHERMAL GRAPH ON A NICKEL–CHROMIUM–MOLYBDENUM STEEL. Special Report No. 24, October 1–December 31, 1963. (Société Anonyme des Forges et Ateliers du Creusot, Le Creusot, France). Work Performed under United States–Euratom Joint Research and Development Program. Contract 073-61-12 RDF. 13p. (A translation)

A graph for continuous cooling transformations was established from data obtained by different methods. On the whole, the results showed good agreement irrespective of the method used. The magnetic method, which is the most sensitive, detects a transformation anomaly (1 to 5%) between 500 and 600°C. This was not observed with the thermal and dilatometric methods. This anomaly, which we call premartensitic, could not be shown under optical micrography. (auth)

39918 (JPRS-26065) INVESTIGATION OF THE PHYSICAL PROPERTIES OF SUBSTANCES AT HIGH TEMPERATURES. I. I. Novikov and P. G. Strelkov. Translated from Vestn. Akad. Med. Nauk SSSR, No. 6, 26-30(June 1964). (TT-64-41335)

Methods were developed for measuring the thermophysical properties of materials at high temperatures. Methods using temperature oscillations were developed to measure heat capacity and thermal conductivity, and results are given for tungsten up to 3600°K. Calorimetric methods are also discussed. Methods for studying liquid metals are discussed, and a graph of the electric conductivity of several alkali metals is given. (D.L.C.)

39919 THE EVALUATION OF CENTROID LATTICE PARAMETER DATA FOR TUNGSTEN BY THE LIKELIHOOD RATIO METHOD. Karl E. Beu (Goodyear Atomic Corp., Piketon, Ohio). Acta Cryst., 17: 1149-54(Sept. 10, 1964).

The likelihood ratio method (LRM) was used to determine $\hat{\alpha}_0$, the maximum likelihood estimate of α_0 for tungsten under the hypothesis of "no remaining systematic errors" in the Bragg angle measurements. $\hat{\alpha}_0$ was determined using centroid Bragg angle and systematic error correction data for tungsten powder. The data were further used to evaluate various characteristics of the LRM related to lattice parameter precision and accuracy. (auth)

39920 WALL PENETRABILITY OF METAL TUBES FOR HELIUM. I. S. Lupakov and Yu. S. Kuzmichev. At. Energ. (USSR), 17: 49-52(July 1964). (In Russian)

Results are presented from studies of helium penetration through pipe walls at temperatures to 800°C and helium pressures to 100 atm. By direct studies using a leak detector it is shown, and by indirect methods (by investigation of structure and determination of protracted strength) it is confirmed, that helium at temperatures to 800°C and pressures to 60 atm does not diffuse from the gas phase through steel. (tr-auth)

39921 THE LEAD-BISMUTH EUTECTIC AS A HEAT TRANSFER MEDIUM. S. J. Stachura and George Burnet (Ames Lab., Ames Iowa). Chem. Eng. Progr., Symp. Ser., 60: 68-75(1964). (IS-579)

The heat transfer properties of the lead-bismuth eutectic are reviewed and compared with those of other high-temperature heat transfer media. New work reported deals

with corrosion, corrosion inhibition, and handling of the eutectic in heat transfer systems. (auth)

39922 INTRODUCTORY REPORT ON GRAPHITE. H. P. Boehm and U. Hofmann (Universität, Heidelberg). Ber. Deut. Keram. Ges., 41: 128-33(Feb. 1964). (In German)

The relationship between the mechanical and electrical properties of graphite and its crystal structure are discussed. The extremely high anisotropy of most properties can be easily measured in both single crystals and platelets of well ordered graphite produced by high-temperature pyrolysis from hydrocarbons. The properties of this pyrolytic graphite were compared with those of unordered polycrystalline graphite. The effects of lattice faults are discussed from the point of view of technical applications of graphite. (auth)

39923 ELECTROGRAPHITE, ITS PRODUCTION, AND PROPERTIES. F. Jeitner, E. Nedopil, and O. Vohler (Siemens-Planiawerke AG, Meitingen, Ger.). Ber. Deut. Keram. Ges., 41: 135-42(Feb. 1964).

The production and properties of artificial carbon and electro-graphite bodies are discussed, including the raw materials, preparation, shaping, firing, and graphitization. It is also shown by what subsequent treatments the properties of artificial carbon and electro-graphite articles can be improved. Particular emphasis is laid on subsequent treatments leading to the improvement of the density, gas permeability, and the resistance of artificial carbon to oxidation attack. Reference is also made to special graphites (pyrographite, cellulose graphite, and glassy carbon). The properties of artificial carbon and electrographite products (made by the classical method and by subsequent treatment) and special graphites are also discussed. (auth)

39924 THE GRAPHITIZATION DEGREE OF ARTIFICIAL GRAPHITES. N. Christu, E. Fitzer, and W. Fritz (Technische Hochschule, Karlsruhe, Ger.). Ber. Deut. Keram. Ges., 41: 143-53(Feb. 1964). (In German)

Original measurements carried out on the fine structure of graphite bodies of different crystallinity are reported. To determine the average crystallite size, $\overline{L_c}$, and the mean square fractional displacement $\langle Z_n^2 \rangle$, in the c-direction the line profiles of basal reflections were analyzed. It is shown that there is a relationship between the mean square fractional displacement and the degree of graphitization g found from the mean interlayer spacings. The amount of information that can be obtained from these structural parameters for describing the technically interesting physical macro-properties of electro-graphites are discussed. (P.C.H.)

39925 PRODUCTION AND PROPERTIES OF A PYROLYTIC CARBON WITH NOT VERY MARKED PREFERENTIAL ORIENTATION. J. Rappeneau, M. Bocquet, M. Yvars, A. Auriol, and C. David (CEN, Saclay and Battelle Memorial Inst., Geneva). Ber. Deut. Keram. Ges., 41: 154-65 (Feb. 1964). (In German)

The apparent density, microstructure, and the preferred orientation of pyrolytic carbons deposited between 1100 and 1800°C were studied. Pyrolytic carbon obtained by thermal decomposition of acetylene, at partial pressures of 0.02 to 0.1 atm on walls heated to between 1550 and 1650°C, was characterized by a low density (1.35 g/cm^3) and a not very marked preferential orientation of the crystallites. This latter property is expressed by an absence of laminar structure in the deposit and by its good compatibility with an artificial graphite substrate. Following a description of the method of deposition and an outline of the structural properties, certain physical and chemical properties of this substance are discussed. (auth)

39926 ELECTROGRAPHITE, A CERAMIC MATERIAL. F. Jeitner, E. Nedopil, and O. Vohler (Siemens-Planiawerke AG, Meitingen, Ger.). Ber. Deut. Keram. Ges., 41: 166-77(Feb. 1964). (In German)

The properties and applications of carbons and ceramic materials were compared. Owing to its resistance to corrosion and to its good thermal conductivity graphite is widely used in the chemical industry. It is only in the case of high mechanical requirements that it cannot replace ceramic materials. In the electrical industry the uses of the two materials are strictly divided because of the difference in their electrical conductivity (one conductor and the other insulator). Only for high temperatures some special ceramics (molybdenum disilicide, boron carbide) are also of significance. In high-temperature technology, graphite has proved to be an excellent material, particularly since in an inert atmosphere it shows practically no creep. In cases of short-term use the better economy with graphite may be of decisive significance. Reference is also made to the applications of graphite in reactors and rockets. (auth)

39927 CRYSTAL STRUCTURES OF THE COMPOUNDS OF Sc WITH SOME TRANSITION METALS. P. I. Krypyakevich, V. S. Protasov, and Yu. B. Kuz'ma. Dopovidi Akad. Nauk Ukr. RSR, No. 2, 212-15(1964). (In Ukrainian)

Compounds of Sc-Mn (66.7 at.% Mn), Sc-Co (50 to 66.7 at.% Co), and Sc-Cu (50 at.% Cu) were melted in inert gas medium and annealed at 600°C. X-ray analysis was made of the phase composition of the resulting solutions. The solutions were identified as $ScMn_2$, $ScCo_2$, ScCo, and ScCu. (TCO)

39928 METALLOGRAPHIC OBSERVATIONS ON ANNEALING AND HIGH TEMPERATURE PROCESSING OF ZIRCALOY-2. A. Bassi and G. Camona (Laboratori CISE, Milan). Energia Nucl. (Milan), 11: 370-8(July 1964).

The effects of annealing and of heat treatments at high temperatures on Zircaloy-2 are examined from the metallographic viewpoint, using a new polishing and etching technique. (auth)

39929 INTERACTION BETWEEN CARBON AND THE TRANSITION METALS OF THE FOURTH, FIFTH, AND SIXTH GROUPS OF THE PERIODIC TABLE. T. V. Fedorov and E. I. Gladyshevskii (Lvov Ivan Franko State Univ., Ukrainian SSR). High Temp., 1: 401-6(Nov.-Dec. 1963). Translated from Teplofiz. Vysokikh Temp., 1: 449-55(Nov.-Dec. 1963).

Binary, ternary, and quaternary systems comprising the transition metals Ti, Zr, Hf, V, Nb, Ta, Cr, Mo, and W, together with carbon are studied with respect to crystal structure and phase diagrams. (N.W.R.)

39930 EXPERIMENTAL DETERMINATION OF THE DEGREE OF BLACKNESS OF Nb AT TEMPERATURES OF 1200-2500°K. V. A. Petrov, V. Ya. Chekhovskoi, and A. E. Sheindlin (Scientific Research Inst. of High Temperature, USSR). High Temp., 1: 416-18(Nov.-Dec. 1963). Translated from Teplofiz. Vysokikh Temp., 1: 462-4(Nov.-Dec. 1963).

Results are presented of an experimental determination of the integral semispherical and monochromatic ($\lambda = 0.66 \cdot 10^{-6}$ m) degrees of blackness of Nb at 1200 to 2500°K. (auth)

39931 THE WIGNER ENERGY AND SAFETY OPERATING CONDITIONS FOR REACTOR GRAPHITE. B. R. Bergelson and G. A. Zorikoev (Inst. of Theoretical and Experimental Physics, Moscow). Inzh. Fiz. Zh., Akad. Nauk Belorussk. SSR, 7: 57-61(July 1964). (In Russian)

By treating the published experimental data on accumulation and annealing of the Wigner energy in reactor graphite the region of safe operating temperatures of this material is defined. Relations obtained allow the operating temperature of graphite to be calculated in every specific case. (auth)

39932 VAPORIZATION RATE OF COMPONENTS DURING THERMAL DISSOCIATION OF YTTRIUM AND LANTHANUM BERYLLIDE. V. M. Amonenko, A. A. Kruglykh, V. S. Pavlov, and G. F. Tikhinskii. Izv. Akad. Nauk SSSR, Met. i Gorn. Delo, No. 3, 158-60(May-June 1964).

The vaporization rates of components were determined in the course of thermal dissociation of YBe_{13} and $LaBe_{13}$. The two compounds were obtained by the thermal-diffusion sintering of powders of the pure metals taken in stoichiometric ratios with a slight excess of Be, which was subsequently driven off by heating to 1050°C in vacuum for 5 hr. The rates of vaporization of YBe_{13} were measured between 1040 and 1290°C and were used to formulate the following expression for the vapor pressure of Be over YBe_{13} for the above temperature range: $\log P = (-16420/T) + 8.30$ (P in mm Hg). The heat of vaporization was 75.0 kcal/mole. The vaporization rates of components in $LaBe_{13}$ were measured between 1080 and 1270°C. The expression derived for the vapor pressure of Be over $LaBe_{13}$ during dissociation of the latter in the above temperature range was $\log P = (-16600/T) + 8.73$. The heat of vaporization was 75.8 kcal/mole. (OTS)

39933 DISSOCIATION OF $\beta-UO_3$. V. G. Vlasov and A. R. Beketov (Urals Polytechnic Inst., USSR). Izv. Vysshikh Uchebn. Zavedenii, Tsvetn. Met., No. 2, 130-4(Mar.-Apr. 1964).

The kinetics of $\beta-UO_3$ dissociation in a vacuum between 525 and 600°C was studied. The formation of the U_3O_{8+x} was demonstrated on the basis of kinetic and x-ray phase methods. The following reaction of phase transformations in the course of $\beta-UO_3$ dissociation was proposed: $\beta-UO_3 \rightarrow U_3O_{8+x} \rightarrow U_3O_8$. The results obtained were evaluated from the point of view of modern concepts of solid state physics and electron mechanisms of chemical reactions. (OTS)

39934 STRUCTURE OF SCANDIUM OXIDE AT VARIOUS TEMPERATURES. V. N. Fedosov, V. A. Liopo, and A. P. Nadol'skii (Irkutsk Polytechnic Inst., USSR). Izv. Vysshikh Uchebn. Zavedenii, Tsvetn. Met., No. 3, 131-2 (1964).

The lattice parameter of scandium oxide was determined during heating. The investigation was carried out with the aid of the USR-50"1" apparatus (Co radiation) equipped with a special specimen holder. Scandium powder was applied to the lateral surface of the holder. The specimen was heated at the rate of two degrees per minute and kept at the desired temperature for 15 min, during which time the specimen was radiographed. The precision of measurement of the interplanar distance was 0.05% and the unit lattice parameter of scandium oxide, 0.005%. The results showed that at 20 and 880°C, all the diffraction lines of Sc_2O_3 are satisfactorily identified as the bcc lattice of Mn_2O_3 having lattice parameters from 9.843 Å at 20°C to 9.9007 Å at 880°C. The data established that no structural changes occurred in the Sc_2O_3 lattice during heating from 20 to 880°C. Values of the lattice parameter and temperature give a straight line when plotted. For the 20–880°C range the coefficient of linear expansion of Sc_2O_3 is 66.6×10^{-6} Å/deg. (OTS)

39935 COMBUSTIBILITY OF ZIRCONIUM–SILICON ALLOYS. V. G. Ioffe (Moscow Inst. of Steel and Alloys). Izv. Vysshikh Uchebn. Zavedenii, Tsvetn. Met., No. 3, 133-6(1964).

The criterion of combustibility was adopted as the ignition temperature of a layer of powder heated gradually while in contact with air. The charge was prepared from zirconium purified by the iodide method and from crystalline silicon of 99.8% purity. The alloys were cast into ingots and then ground up. The main purpose of the investigation was to find the dependence of the ignition temperature on the alloy composition, i.e., plotting the combustion diagram of the Zr–Si system. In addition, in order to verify the method, the dependence of ignition temperature to heating rate and fineness of the powder was investigated. It was found that the ignition temperature of a Zr–Si alloy depends on its composition, and that this dependence is not additive. The ignition temperature of a Zr–Si alloy powder ranges from 235 to 845°C. The shape of the combustion curve is determined by a superposition of a line similar to the liquidus line of the Zr–Si phase diagram onto the straight line representing the content of the less pyrophoric component in the alloy. This shape of the combustion curve is explained by the decisive part played by the appearance of the liquid phase in the mechanism of ignition. (OTS)

39936 THE LATTICE THERMAL CONDUCTIVITY OF AN ISOTOPICALLY DISORDERED CRYSTAL. A. A. Maradudin (Westinghouse Research Labs., Pittsburgh). J. Am. Chem. Soc., 86: 3405-13(Sept. 5, 1964).

Starting from the Kubo expression for thermal conductivity, a calculation of the lattice thermal conductivity of an isotopically disordered cubic Bravais crystal is carried out to lowest order in the concentration of the minority constituent (the impurities). It is shown that to this order in the concentration the expression for the conductivity has the form predicted by simple kinetic theory arguments, in the case that the impurity atoms are heavier than the atoms of the host crystal. The reciprocal of the phonon lifetime in this case has a resonance character of the type discussed recently by Brout and Visscher. (auth)

39937 THE LORENTZ-LORENZ FUNCTION OF THE SOLIDIFIED RARE GASES. Robert M. Mazo (Univ. of Oregon, Eugene). J. Am. Chem. Soc., 86: 3470-4(Sept. 5, 1964).

A theory of the deviation of the Lorentz-Lorenz function, $(n^2-1)/(n^2+2)p$, for the solid rare gases from its gas phase value is given. A tight binding exciton model for the excitations in the solid and the mathematical formalisms of second quantization and quantum mechanical Green's functions are used. The results are in reasonable agreement with experiment. Limitations of the model are discussed, and a physical explanation of the results is given in terms of virtual excitations of excited free atom states in the many body ground state of the crystal. (auth)

39938 DIFFUSION-INDUCED DISLOCATIONS IN SILICON. J. Washburn (Univ. of California, Berkeley), G. Thomas, and H. J. Queisser. J. Appl. Phys., 35: 1909-14(June 1964). (UCRL-11102)

Plastic deformation produced by phosphorus diffusion

into a (001) silicon surface was studied by transmission electron microscopy. The lattice parameter differences in regions of steep solute concentration gradient were accommodated by a crossed grid of edge dislocations having Burgers vector a/2[110] and a/2[110]. The long edge dislocations end at nodes, which suggests that they are formed by dislocation reactions between pairs of dislocations that can glide into the crystal on {111} planes. (auth)

39939 EXCHANGE STRICTIONS OF THE SINGLE CRYSTAL OF GADOLINIUM. Takashi Tonegawa (Osaka Univ.). J. Phys. Soc. Japan, 19: 1168-77(July 1964).

The forced magnetostriction and anomalous thermal expansion of the single crystal of gadolinium are theoretically investigated by calculating the strain dependence of the indirect exchange interaction via the conduction electrons. The calculations are based on Yosida and Watabe's theory. However, if the conduction electrons are assumed to be free electrons giving rise to a spherical Fermi surface, the calculations do not well account for the observed large anisotropy of these quantities. An improvement of the calculation is presented, which takes into account a possible asphericity of the Fermi surface and which can account for the observation. (auth)

39940 MÖSSBAUER STUDY OF INVAR-TYPE IRON–NICKEL ALLOYS. Yoji Nakamura (Kyoto Univ.), Masayuki Shiga, and Naomoto Shikazono. J. Phys. Soc. Japan, 19: 1177-81(July 1964).

By means of the Mössbauer effect internal magnetic fields at iron atom in invar-type iron–nickel alloys were measured using fine powdered samples in which the $\gamma \rightarrow \alpha$ martensitic transformation can be suppressed. The absorption spectra of 30 and 32% iron–nickel alloys have a marked feature that a paramagnetic absorption line coexists with normal ferromagnetic ones even at liquid nitrogen temperature which is well below the Curie temperature. The internal magnetic field was found to be nearly constant at 330 kOe over the composition range, and the sharp decrease of saturation magnetization of alloys around the composition can semiquantitatively be explained when both of intensities of ferromagnetic and paramagnetic lines are taken into consideration. (auth)

39941 NUCLEAR MAGNETIC RESONANCE IN THE FERROMAGNETIC INTERMETALLIC COMPOUND $ZrFe_2$. Hiroshi Betsuyaku (Japan Atomic Energy Research Inst., Tokyo), Shigehiro Komura, and Yasuko Betsuyaku. J. Phys. Soc. Japan, 19: 1262-3(July 1964).

The observation of the NMR signal in the ferromagnetic intermetallic compound $ZrFe_2$ is reported. It was concluded that the ^{91}Zr nuclei were responsible for the signal. (C.E.S.)

39942 RATES OF PERMEATION AND DIFFUSION COEFFICIENTS OF HYDROGEN AND DEUTERIUM THROUGH PALLADIUM. Genjiro Toda (Rikkyo Univ., Tokyo). J. Res. Inst. Catalysis, Hokkaido Univ., 12: 39-55(May 1964).

The rates of permeation of hydrogen and deuterium through palladium wire fused in glass, along its axis from its one end in the respective gas of pressure P toward the other end in vacuum were measured. The permeation rate of hydrogen $V_P^{H_2}$ and its ratio to that $V_P^{D_2}$ of deuterium were determined as $V_P^{H_2} = (1.41 \times 10^{-2}/l)\sqrt{P} \exp[-(3220/RT)]$ cc(NTP)/sec cm^2, mm thick, and $V_P^{H_2}/V_P^{D_2} = 1.8 \exp[-(80/RT)]$, where l is the length of the palladium wire fused in glass (mm), and T the absolute temperature; the observation ranged from 3.6 to 63 cmHg of P or from 14 to 53 cmHG of P respectively in case of hydrogen or deuterium and from 443° to 563°K of T. Under these experimental conditions it was verified that the permeation is controlled by diffusion through palladium metal, the diffusion coefficient of hydrogen D^H and its ratio D^H/D^D to that D^D of deuterium were determined as $D^H = 5.96 \times 10^{-3} \exp[-(5650/RT)]$ cm^2/sec, and $D^H/D^D = 2.45 \exp[-(850/RT)]$, with reference to the known solubility data of hydrogen and of deuterium in palladium. The diffusion coefficients of hydrogen and deuterium in palladium were theoretically calculated, on the other hand, on the basis of a model that the diffusion consists in the transition of proton or deuteron from a position of the lowest potential energy to the nearest similar one through the path of the least potential energy, where the potential energy is the total sum of the screened coulombic repulsive potential energy, i.e., $V = (Ze^2/r)e^{-\lambda r}$ due to each palladium ion; r is the distance from the proton or the deuteron to the palladium ion, Z the effective charge of palladium ion and λ the coefficient of shielding effect of proton or deuteron by electron cloud. Calculated values of the diffusion coefficients of hydrogen and deuterium were found in accordance with the observed ones for Z = 1 and $\lambda = (1/0.34) \sim (1/0.42)$ Å^{-1}, which are theoretically reasonable values. (auth)

39943 A METHOD FOR ACCURATE MELTING POINT DETERMINATION AT HIGH TEMPERATURES. B. Riley (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Sci. Instr., 41: 504-5(Aug. 1964). (AERE-M-1364)

An accurate method of determining the melting points of solids is described within the temperature range of 800 to 3000°C by observing optically the collapse of a specimen under "black-body" conditions. (auth)

39944 TEMPERATURE CYCLING BEHAVIOR OF URANIUM WITH VARIOUS ORIENTATIONS. I. Quaeck (Zentralinstitut für Kernforschung, Rossendorf, Ger.). Kernenergie, 7: 420-6(June-July 1964). (In German)

The effects of orientation and changes in orientation during temperature cycling of uranium were investigated by determining changes in textural and dimensional characteristics. The tests were performed in the alpha region, in the transitional region between alpha and beta, and in the beta region. No significant texture changes occurred in the alpha region; the dimensional changes conformed to Pugh's deformation mechanism. Changes in the other orientation tests were more complex; the possible mechanisms and factors responsible for the observed variations are discussed. (auth)

39945 STUDY OF THE La_2O_3–BeO PHASE DIAGRAM. C. K. Koo and T. S. Yen. K'o Hsueh T'ung Pao, No. 5, 455-6(1964). (In Chinese)

In view of their excellent high-temperature properties, of interest for the nuclear industry, the solubility of the La_2O_3–BeO system and the properties of the compounds $La_2O_3 \cdot 2BeO$ and $La_2O_3 \cdot BeO$ were examined. The phase diagram was obtained by the annealing method, and the structure of the samples was determined by means of the polarizing microscope and from x-ray-diffraction pictures. The temperature of the annealing, carried out in W and Pt fumaces, was determined by comparison with pure standard compounds. The phase diagram revealed the existence of two new compounds, $La_2O_3 \cdot 2BeO$ and $3La_2O_3 \cdot 2BeO$; the latter has a high solubility in BeO. It was found that the Be compounds are less stable than the corresponding Si or B compounds. The extremely flat liquidus curve of $3La_2O_3 \cdot$

2BeO indicates that the BeO decomposes when the melting point is approached. It was also established that a mixture containing 40 to 53% $LaO_{1.5}$ heated to a temperature above the liquidus line will devitrify upon sudden quenching. (TTT)

39946 STUDY OF THE BeO LIQUIDUS LINE IN THE La_2O_3–BeO PHASE DIAGRAM. C. K. Koo and T. S. Yen. K'o Hsueh T'ung Pao, No. 5, 457-8(1964). (In Chinese)

The ionic structure of BeO in the $La_2O_3 \cdot 2BeO$, $3La_2O_3 \cdot 2BeO$ compounds and in solution is assumed to be $Be_2O_5^{6-}$ and BeO_4^{6-}. The liquidus line of BeO in the La_2O_3–BeO system was determined on the basis of the thermodynamic relationship of the mixtures possessing decreasing melting points. Separate curves were prepared for the La_2O_3, $La_2O_3 \rightarrow 2La^{3+} + 3O^{2-}$, $La_2O_3 + 2BeO \rightarrow 2La^{3+} + Be_2O_5^{6-}$ and $La_2O_3 + BeO \rightarrow 2La^{3+} + BeO_4^{6-}$ systems. The calculated values of the BeO liquidus line were found to be higher than the experimentally obtained data. From this it is concluded other ions are present in the system, in addition to $Be_2O_5^{6-}$ and BeO_4^{6-}, lowering the liquidus temperature. It is assumed that compound ions, such as $(BeO_{1.5}^{-})$ and $(BeO_2^{2-})_n$, with O/Be atomic ratios smaller than 2.5, are produced by the interaction of $Be_2O_5^{6-}$ and BeO in the BeO–$La_2O_3 \cdot 2BeO$ system. Recalculating the liquidus temperature of BeO on the basis of the above assumption, values agreeing with the experimental data were obtained. (TTT)

39947 EFFECT OF BERYLLIUM ON MAGNESIUM AND ITS ALLOYS. PART IV. Hisatsune Chuyo and Hagihara Tsutomu. Light Metals, No. 67, 43-9(Mar. 1964). (In Japanese)

Studies showed that the addition of small amounts of Be, Ca, Sr, and Ba tend to increase the grain size of commercially pure Mg and Mg-6% Al alloys. Grain coarsening showed no clear relation to the supercooling phenomena. (Rev. Metal Lit., 21: No. 7, July 1964)

39948 CRYSTALLIZATION IN THE Be–Nb SYSTEM. N. D. Narodskaya, L. V. Molchanova, M. V. Raevskaya, A. V. Novoselova, I. N. Fridlyander, K. P. Yatsenko, and L. K. Rogova. Metalloved. i Term. Obrabotka Metal., No. 6, 12-15(June 1964)

The beryllium-rich portion of the Be–Nb system containing 58% by weight Nb was investigated. Data are presented on the microstructure and hardness of cast specimens annealed and quenched from 850°C. The solubility of niobium in beryllium in the solid state is very low. In the microstructure of an alloy containing 0.7% by weight Nb significant amounts of the second phase are present. The gamma-phase crystallizes together with beryllium. Eutectic crystallization $\rightleftharpoons \alpha + \gamma$ of a melt occurs for an Nb content of 2.5% by weight. The temperature of eutectic crystallization is very near the melting temperature of pure beryllium. The eutectic structure of alloys of eutectic and hypoeutectic composition is very fine, however with a sufficient number of primary metallide formations the fine eutectic disappears. In many hypereutectic alloys the structure of the upper and lower portion of the ingot is different due to differences in the specific weight. In such cases a purely eutectic structure is often observed in the upper part of the ingot. (OTS)

39949 PROPERTIES OF CERAMIC-COATED NUCLEAR-FUEL PARTICLES. J. M. Blocher, Jr., M. F. Browning, W. J. Wilson, V. M. Secrest, A. C. Secrest, R. B. Landrigan, and J. H. Oxley (Battelle Memorial Inst., Columbus, Ohio). Nucl. Sci. Eng., 20: 153-70(Oct. 1964).

Of the several factors tending toward failure of fuel-particle coatings in irradiation, fuel swelling, and radiation damage to the first 15–20 μm of coating by fission recoils are concluded to deserve the greatest immediate attention. Whereas ceramic coatings of sufficient thickness might withstand the stress, thinner coatings containing cushion layers or voids can be designed in principle to accommodate the effects of radiation damage. This was demonstrated for pyrolytic carbon and alumina coatings formed by chemical vapor deposition reactions. These principles cannot be applied to oriented coatings whose grains suffer anisotropic radiation damage by neutrons. This factor may ultimately limit the applicability of BeO coatings. Crushing strength, density, and hardness data are presented which show that pyrolytic carbon coatings with the same microstructure can have a wide range of properties. It is concluded that pyrolytic carbon coatings are not properly characterized by the terms laminar and columnar frequently used to describe their appearance. In the case of Al and Be coatings obtained by hydrolysis of the respective chloride vapors, deposition temperature is the most significant factor determining grain structure and permeability. Al_2O_3 coatings range from porous amorphous varieties, through an impermeable glass to elongated grains extending through the coating. The equivalent of the Al_2O_3 glass was not observed in the BeO coatings. MgO coatings can be expected to be of limited utility because of low strength. ZrO_2 coatings have the deficiency of permitting rapid oxygen diffusion. (auth)

39950 URANIUM MONONITRIDE — A NEW REACTOR FUEL. J. Bugl and D. L. Keller (Battelle Memorial Inst., Columbus, Ohio). Nucleonics, 22: No. 9, 69-70(Sept. 1964).

The results of studies on the electrical, mechanical, structural, thermal, and thermodynamic properties; cladding compatibility; and corrosion resistance of UN, as well as on the preparation of UN, fabrication of UN compacts, and radiation effects on UN are reviewed. Some comparisons with the properties of other uranium compounds are included. (D.C.W.)

39951 POROUS REFRACTORIES FROM MAGNESIUM OXIDE. I. Ya. Guzman and G. A. Serova (Chemical Tech. Inst., USSR). Ogneupory, No. 6, 281-4(1964).

The results of an investigation of porous articles made from magnesium oxide as compared to dense refractories are reported. Magnesium oxide was used to prepare a permeable, relatively strong, and highly refractory material of 30–60% porosity containing ~98% MgO. Variation of the filler grain size, filler-to-binder ratio, and the content and granular composition of the additives, which are burned off, made it possible to control the properties of articles made of magnesium oxide over a wide range. Porous periclase refractories are distinguished by a high refractorability and gas permeability, and a low thermal conductivity. They may be used as high-temperature insulators in the absence of high loads and abrupt temperature changes. They are suitable for use as filters in corrosive media where highly refractory materials are required. (OTS)

39952 SIGN OF THE MAGNETIC HYPERFINE FIELD IN DILUTE IRON ALLOYS USING THE MÖSSBAUER EFFECT. Norman Blum and Lee Grodzins (Massachusetts Inst. of Tech., Cambridge). Phys. Rev., 136: A133-7 (Oct. 5, 1964). (MIT-2098-56)

The sign of the hyperfine field in several dilute iron alloys was determined. The technique makes use of the Mössbauer effect, which is used to establish the helicity of

gamma rays emitted and absorbed in a longitudinal magnetic field. Experiments were performed which show that the field induced at the iron nucleus by the application of an external magnetic field H_0 is negative (i.e., opposite to H_0) in Mössbauer sources of ^{57}Co in Cu and Au and in absorbers of Mo and Rh containing about 1% ^{57}Fe. The spontaneous field H_{int} observed in a ½% ^{57}Fe-in-Cr alloy below 50°K is positive. (auth)

39953 ANOMALOUS RESISTIVITY OF Nb_3Sn. D. W. Woodard and G. D. Cody (Radio Corp. of America, Princeton, N. J.). Phys. Rev., 136: A166-8(Oct. 5, 1964).

The resistivity of several specimens of niobium stannide was measured over the range 18–850°K. The resistivity rises rapidly up to 200°K and then approaches a linear variation with a considerably smaller slope. Over the entire range the resistivity can be fit to better than 1% by the form $\rho(T) = \rho_0 + \rho_1 T + \rho_2 \exp(-T_0/T)$ where $\rho_0 \approx 1 \times 10^{-5}$ Ω-cm, $\rho_1 = 4.66 \times 10^{-8}$Ω-cm/°K, $\rho_2 = 7.47 \times 10^{-5}$Ω-cm, and $T_0 = 85$°K. Hall measurements made at 27, 77, and 300°K, if interpreted on a one-band model, indicate a constant hole density of 1.77×10^{22}/cc, and an effective valence of 0.27/atom. The anomalous resistivity can not be explained on the basis of present models of the resistivity of transition metals, although the constancy of the Hall constant implies that the scattering probability rather than the effective number of carriers is changing with temperature. The relevance of the present results to recent models of the electronic structure of Nb_3Sn is discussed. (auth)

39954 MAGNETIC ORDER IN RARE-EARTH INTERMETALLIC COMPOUNDS. J. W. Cable, W. C. Koehler, and E. O. Wollan (Oak Ridge National Lab., Tenn.). Phys. Rev., 135: A240-2(Oct. 5, 1964).

Neutron diffraction measurements were made on a series of rare-earth intermetallic compounds to determine the type of magnetic order and its relation to the number of valence electrons in the system. The compounds studied included TbCu, TbZn, TbGa, TbAg, TbHg, and TbIn. The compounds with Cu, Zn, Ag, and Hg were found to have the CsCl-type structure, TbGa the CrB-type structure, and TbIn a complex tetragonal unit cell. TbGa is ferromagnetic with a Curie temperature of 155°K, while TbIn is antiferromagnetic below 190°K. For the compounds with the CsCl structures, TbCu and TbAg are antiferromagnetic with Néel temperatures of 115 and 100°K, while TbZn and the TbHg are ferromagnetic below 160 and 80°K, respectively. This difference in magnetic behavior of the compounds with group Ib and IIb metals must be associated with the number of valence electrons rather than with interatomic separations because the lattice constants of the two groups overlap. (auth)

39955 THE DE HAAS-VAN ALPHEN EFFECT IN ALKALI METALS. D. Shoenberg and P. J. Stiles (Cambridge Univ., Eng.). Proc. Roy. Soc. (London), Ser. A, 281: 62-91(Aug. 25, 1964).

A new method for studying the de Hass–van Alphen effect in steady magnetic fields has been developed in which the field is modulated at frequency ω and a signal at frequency 2ω is generated in a pick-up coil round the specimen because of the non-linear field dependence of magnetization. The rectified 2ω signal is proportional to d^2M/dH^2 and so shows de Haas–van Alphen oscillations either when H is varied for fixed orientation or when the orientation is varied in fixed H if the Fermi surface is anisotropic. Because the phase of oscillation is very high (of order $10^4\pi$) even very slight anisotropy will produce a few oscillations when the orientation is varied and the method is therefore particularly sensitive for studying very nearly spherical Fermi surfaces. From the oscillations with H, values of the frequency F were found for sodium, potassium, rubidium, and cesium, which were close to those predicted for a free-electron sphere containing 1 electron per atom, though some small systematic deviations of order ½% were observed, which may be significant. From detailed study of the oscillations produced by rotation of single crystals in fixed H it was found possible to describe the orientation dependence of F (proportional to the area of cross section of the Fermi surface) for potassium and rubidium consistently by a series of cubic harmonics and hence to deduce the small departures of the Fermi surfaces from spherical shape. The deviations from a sphere were found to be of the order of 1 part in 10^3 for potassium and a little less than 1 part in 10^2 for rubidium; these deviations are compared with those predicted by band structure calculations. Preliminary results for sodium suggest that it is appreciably less anisotropic than potassium. Some results are also reported on the temperature and field dependence and the absolute amplitude of the de Haas–van Alphen effect, and it is also shown how the effect can be used to measure very small variations of field with position. (auth)

39956 THE LATTICE METRIC OF $CaZrTi_2O_7$ CRYSTALS. Yu. A. Pyatenko and Z. V. Pudovkina (Inst. of Mineralogy, Geochemistry, and Crystallochemistry of Rare Elements, [Academy of Sciences,] USSR). Soviet Phys. Cryst. (English Transl.), 9: 76-8(July-Aug. 1964). Translated from Kristallografiya, 9: 98-100(Jan.-Feb. 1964).

Single crystal grains of $CaZrTi_2O_7$ were obtained by sintering stoichiometric quantities of the corresponding oxides and subsequently annealing the samples at 1450°C for 45 hr. Separate single crystal fragments of 0.2–0.3 mm size were separated and subjected to x-ray examination. Analysis of the Debye powder pattern led to the idea that the $CaZrTi_2O_7$ structure inherits the fundamental features of the simple and well-known cubic form CaF_2–CeO_2. Data on the structure of $CaZrTi_2O_7$ are tabulated. (P.C.H.)

39957 CRYSTAL STRUCTURE OF THE COMPOUND $HfCr_2$. S. P. Alisova, P. B. Budberg, and K. I. Shakhova (Baikova Inst. of Metallurgy, [Academy of Sciences,] USSR). Soviet Phys. Cryst. (English Transl.), 9: 78-9(July-Aug. 1964). Translated from Kristallografiya, 9: 100-1(Jan.-Feb. 1964).

In order to determine its lattice spacings $HfCr_2$ was examined by the back reflection technique in the KROSS camera with Cr radiation. Lattice constant values obtained were a = 5.056 kX, c = 8.215 kX, c/a = 1.625. It was thus established that $HfCr_2$ has the $MgZn_2$ structure, characteristic of high temperature modifications of the Cr compounds of Ti, Nb, and Ta. X-ray-diffraction photographs of alloys annealed in states (1100°C for 50 hr, 1000°C for 75 hr, 800°C for 100 hr, 600°C for 150 hr) contained a system of lines corresponding to the structural type $MgCu_2$ (C 15). (P.C.H.)

39958 X-RAY DETERMINATION OF THE THERMAL EXPANSION COEFFICIENTS OF LaS, CeS, PrS, AND NdS. N. N. Zhuravlev, A. A. Stepanova, and M. P. Shebatinov (Moscow State Univ.). Soviet Phys. Cryst. (English Transl.), 9: 95-6(July-Aug. 1964). Translated from Kristallografiya, 9: 116-17(Jan.-Feb. 1964).

To determine the values of the thermal expansion coefficients of LaS, CeS, PrS, and NdS, x-ray photographs were made in vacuo at various temperatures (room temperature to 400°C) in the 190 mm dia Unicam camera with copper radiation. The lattice spacings of the monosulfides varied

linearly with temperature in the interval stated, within the limits of experimental error. The presence of metallic conductivity was confirmed by the small magnitude of $\Delta < 14.5\%$. Data are tabulated. (P.C.H.)

39959 STUDY OF THE ANOMALOUS SCATTERING OF X RAYS IN MICROSCOPICAL SINGLE CRYSTALS OF ALLOYS. THE FIRST STAGE OF AGING IN NICKEL–BERYLLIUM AND COPPER–BERYLLIUM ALLOYS. Yu. D. Tyapkin and A. V. Gavrilova (Bardin Central Scientific Research Inst. for Ferrous Metallurgy, USSR). Soviet Phys.-Cryst. (English Transl.), 9: 166-71(Sept.-Oct. 1964). Translated from Kristallografiya, 9: 213-18 (Mar.-Apr. 1964).

The first stages of aging in nickel–beryllium and copper–beryllium alloys was studied by means of the anomalous scattering of x rays at separate microscopical (10–100 μ) single crystals. It was found that in the first stages of aging in nickel–beryllium alloy (aging temperature 425°) and copper beryllium alloy (200°), in the very first minutes of tempering the beryllium atoms gathered into thin (one-two atomthick) plate-like regions (Guinier-Preston zones) parallel to the $\{100\}$ planes of the matrix. The residual solid solution, moreover, rapidly became impoverished almost to the equilibrium composition for the aging temperature. As a result of the large difference in atomic volumes between the zones and the surrounding impoverished matrix, there arose large shearing stresses, characterized by the displacement of atomic planes $\{100\}$ in the $\langle 110 \rangle$ directions lying in these planes. (auth)

39960 CRYSTAL STRUCTURE OF $ScBe_5$. V. S. Protasov and E. I. Gladyshevskii (Franko State Univ., L'vov). Soviet Phys.-Cryst. (English Transl.), 9: 208-9 (Sept.-Oct. 1964). Translated from Kristallografiya, 9: 267-8(Mar.-Apr. 1964).

Studies were made to determine the existence of Sc-rich compounds in Sc–Be alloys. The results for an alloy containing (initially) 84 at.% Be are reported. It was established that the Sc–Be alloy contains a compound $ScBe_5$ isostructural with $ZrBe_5$ and $HfBe_5$. Alloys containing more Be confirmed the existence of $ScBe_{13}$; they also revealed a further compound, which probably belongs to one of the R_2X_{17} structure types. (P.C.H.)

39961 CRYSTAL STRUCTURE OF MAGNESIUM–RICH PHASES IN ALLOYS OF THE MAGNESIUM–CERIUM AND MAGNESIUM–NEODYMIUM SYSTEMS. N. F. Lashko and G. I. Morozova. Soviet Phys.-Cryst. (English Transl.), 9: 209-11(Sept.-Oct. 1964). Translated from Kristallografiya, 9: 269-70(Mar.-Apr. 1964).

Four heterophase alloys containing 1.1 and 3.37 at.% and 1.1 and 3.71 at.% Nd, respectively, and also an alloy containing 9 at.% Nd were investigated. In alloys of the Mg–Ce and Mg–Nd systems Mg-rich phases corresponding to the tetragonal crystal structure of type $Mn_{12}Th$ exist. In alloys of the Mg–Ce system a Mg-rich phase with crystal structure of type $Ni_{17}Th_2$ exists. A third Mg-rich phase in alloys of the Mg–Ce and Mg–Nd systems may possibly be a polymorphic modification of the $Mg_{12}Me$ or $Mg_{12}Me_2$ phases. (P.C.H.)

39962 STRONTIUM BERYLLIDE. N. N. Matyushenko, L. F. Verkhorobin, and V. N. Karev (Physicotechnical Inst., Academy of Sciences, Ukrainian SSR). Soviet Phys.-Cryst. (English Transl.), 9: 213-14(Sept.-Oct. 1964). Translated from Kristallografiya, 9: 273-5(Mar.-Apr. 1964).

Strontium beryllide was prepared and the following properties were established: stoichiometric formula $SrBe_{13}$, crystal structure $NaZn_{13}$ type, space group O_h^6 – Fm3c, parameters y = 0.175, z = 0.110, cubic lattice spacing a = 10.157 ± 0.001 Å. The calculated density was $\rho = 2.35$ g/cm^3. (P.C.H.)

39963 THE SYMMETRY OF β-URANOPHANE. V. I. Mokeeva (Vernadskii Inst. of Geochemistry and Analytical Chemistry, Moscow). Soviet Phys.-Cryst. (English Transl.), 9: 215(Sept.-Oct. 1964). Translated from Kristallografiya, 9: 275(Mar.-Apr. 1964).

Photographs were taken of the zero layer lines with rotation about the three axes, and also of the second (strong), first (weak), and third (weak) layer lines on rotation about the c axis in β-uranophane. Analysis of the intensities of the reflections of all layer lines was used to determine the symmetry of β-uranophane. Photographs of the weak layer lines (first and third), obtained on rotation about c, do not possess monoclinic symmetry, since the intensities of the reflections (hkl), ($\bar{h}$kl), (h$\bar{k}$l), and ($\bar{h}\bar{k}$l) are all different. Consequently, β-uranophane is pseudo-monoclinic, with a pseudo-space group $P2_1/c$, and the true symmetry is triclinic, so that the space group is Pl or P$\bar{1}$. (P.C.H.)

39964 CRYSTAL STRUCTURES OF THE COMPOUNDS RIn_3 IN RARE EARTH METAL–INDIUM SYSTEMS. Yu. B. Kuz'ma and V. Ya. Markiv (L'vov State Univ.). Soviet Phys.-Cryst. (English Transl.), 9: 218-20(Sept.-Oct. 1964). Translated from Kristallografiya, 9: 279-80(Mar.-Apr. 1964).

Crystal structures of the compounds RIn_3 where R = Y, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, and Lu were investigated. Calculation of the x-ray photographs obtained showed that (with the exception of the Eu alloy) all the photographs contained not only the indium lines but also other lines indicating cubic structure. Thus the alloys investigated consist of binary compounds existing in equilibrium with In. The ratio of the quantities of In and binary alloy in each of the alloys examined was approximately 3 : 1. The primitive lattice type and the values of the lattice spacings in the compounds indicate the $AuCu_3$ type of structure (space group Pm3m – O_h). (P.C.H.)

39965 THE EFFECT OF CONDITIONS OF PREPARATION ON THE STRENGTH OF WC–Co HARD ALLOYS AND THE RELATIONSHIP BETWEEN THE STRENGTH OF THESE ALLOYS AND THEIR STRUCTURE AND COMPOSITION. V. A. Ivensen. Soviet Powder Met. Metal Ceram. (English Transl.), No. 3, 203-13(May-June 1963).

The effects of preparation conditions of the initial tungsten powders and the grinding and sintering conditions on the strength of a hard alloy during bending were investigated. The influence of the size of the carbide grain, cobalt content, and carbide dispersity on the strength of the alloy was studied. It is indicated that relations actually existing may be explained on the basis of the skeleton structure of the carbide and cobalt phases. (Rev. Metal Lit., 21: No. 7, July 1964)

39966 X-RAY DIFFRACTION STUDY OF THE SYSTEM TUNGSTEN–RHENIUM–CARBON. Yu. B. Kuz'ma, V. I. Lakh, V. Ya. Markiv, B. I. Stadnyk, and E. I. Gladyshevskii. Soviet Powder Met. Metal Ceram. (English Transl.), No. 4, 286-92(July-Aug. 1963).

The ternary system W–Re–C was studied by x-ray structural analysis to determine the influence of carbon on the composition and properties of W–Re thermocouples. Phase equilibria were established for as-cast alloys and alloys quenched from 2000, 1500, 1000, and 800°C. (Rev. Metal Lit., 21: No. 7, July 1964)

39967 THE THERMAL AND ELECTRICAL PROPERTIES OF SEVERAL ALLOYS OF THE RHENIUM–NICKEL SYSTEM. P. I. Kirichenko and V. E. Mikryukov (Krzhizhanovskii Power Inst., USSR). Teplofiz. Vysokikh Temp., 2: 199-204(1964).

Results are given of measurements of the coefficients of temperature conductivity, thermal conductivity, and electrical resistivity from 293.3 to 1,123.3°K and Wiedermann-Franz ratios and thermal conductivity from 293.3 to 873.3°K for alloys of the rhenium–nickel system are described. The methods used are described. The specimens investigated were cylindrical bars measuring 300 mm in length and 3 mm in diameter. The specimens were prepared from sheet nickel of 99.999999% purity and rhenium powder of a purity corresponding to an All-Union State Standard (GOST). Alloys were obtained by melting in a vacuum furnace, for which rhenium was first pressed into rods. They were then drawn into wire. For measuring the electrical conductivity of nickel, a specimen was cut from the sheet, upset and drawn by hand forging. All of the investigated alloys have comparatively low thermal and electrical conductivity in the sense of Mikryukov criterion; the process of heat transfer in the alloys investigated was accomplished by conduction electrons and lattice thermal conductivity; use of the improved method for measuring temperature conductivity eases and speeds up experiments, and use of the method for measuring thermal conductivity permits widening the range of investigations. (TCO)

39968 ON THE QUESTION OF THE INTERACTION OF NIOBIUM CARBIDE AND TUNGSTEN. Yu. N. Vil'k, R. G. Avardbe, V. S. Neshpor, T. P. Ryzhkova, and Yu. A. Omelchenko (State Inst. of Applied Chemistry, USSR). Teplofiz. Vysokikh Temp., 2: 274-9(1964).

An investigation of the phase equilibrium between tungsten and the carbides of niobium $NbC_{0.98}$ (5–95% by weight W) and $NbC_{0.85}$ (5–50% by weight W) in the temperature interval of 2,000–3,000°C using methods of metallographic and x-ray analyses and measurement of microhardness are presented. The investigated sections W–$NbC_{0.98}$ and W–$NbC_{0.85}$ are not pseudobinary and pass through the region of two-phase equilibriums (in the solid state) $\alpha + \delta$ (solid solutions based on W and W_2C), $\alpha + \gamma$ (solid solutions based on W and NbC) and $\gamma + \beta$ (solid solutions based on NbC and Nb_2C) and a region of triple-phase equilibrium $\alpha + \delta + \gamma$. The existence of ternary compounds of the W–Nb–C system in the investigated region of alloy compositions was not detected. A liquid phase in the investigated region of the ternary system W–Nb–C exists at temperatures of a minimum of 2,600°C. A binary eutectic $\alpha - \delta$, a trinary eutectic $\alpha - \delta - \gamma$, and a trinary peritectic $\alpha - \beta - \gamma$ exist in the investigated region of the ternary system W–Nb–C. Hypothetical isothermal sections of the concentration triangle W–Nb–C for temperatures of 2,000, 2,600–2,700 and 3,000°C, and also a polythermic W–NbC section were constructed. (TCO)

39969 SOLUBILITY OF CERIUM IN NICKEL AND MECHANICAL PROPERTIES OF NICKEL–CERIUM ALLOYS. U. K. Duysemaliev. Tr. Inst. Met. i Obogashch., Akad. Nauk Kaz. SSR, 10: No. 3, 59-62(1964).

The structure and properties of alloys of the nickel–cerium system pertaining to the region rich in nickel were studied. Microstructure analysis and measurements of phase microhardness, Brinell hardness, and electrical resistance were used. Cast ingots were hot-forged to 10 × 10 mm, sealed in an evacuated quartz ampule, and heated to 800°C for 100 hr, then cooled by 100°C every 24 hr. Brinell hardness was determined with a 250-kg load and 5-mm ball. Microhardness was measured with a PMT instrument with a 20-g load. The strength and ductility of the alloys were determined under static tension. To measure the electrical resistance at room temperature by the potentiometric method, annealed specimens were manually rolled and drawn through dies to a cross section 0.5 mm in diameter. Cerium in amounts of 0.05% refines the grain of nickel and forms a solid solution; a further rise in Ce content causes the formation of two phases where inclusions of the compound Ni_5Ce appear. The solubility of Ce in nickel at room temperature was found to be low (about 0.10 wt %). The limit of solubility of cerium in nickel was determined by quenching the alloys from 500, 900, and 1200°C. The solubility was maximum at 1200°C (0.125 wt % Ce). Measurements of alloy strength showed that addition of Ce to Ni causes it to increase, particularly in the range of the solid solution (from 49.6 to 53.4 kg/mm^2). The most ductile alloy at room temperature was one containing 0.05% Ce. (OTS)

39970 DYNAMIC YOUNG'S MODULUS MEASUREMENTS ABOVE 1000°C ON SOME PURE POLYCRYSTALLINE METALS AND COMMERCIAL GRAPHITES. Philip E. Armstrong and Harry L. Brown (Los Alamos Scientific Lab., N. Mex.). Trans. AIME, 230: 962-6(Aug. 1964). (LADC-6100)

Young's modulus data are presented for W, Mo, Ta, V, Cr, Ni, Ti, and Zr as a function of temperature up to about 0.7 of the melting points. A plot of reduced temperature vs reduced modulus produced a general correlation except for titanium and zirconium. Young's modulus data for some representative commercial graphites are given up to 2400°C. All results were obtained from longitudinal resonance-frequency measurements of 4-in. long samples, corrected for simultaneously measured thermal expansion. Comparison of polycrystalline and single-crystal tungsten behavior indicated that all the observed modulus values are frequency-dependent at the higher temperatures. (auth)

39971 THE PLUTONIUM–CERIUM SYSTEM. J. E. Selle and D. E. Etter (Monsanto Research Corp., Miamisburg, Ohio). Trans. AIME, 230: 1000-5(Aug. 1964).

The Pu–Ce phase diagram was determined by differential thermal analysis, metallography, and electron-microprobe analysis. The diagram is characterized by a eutectic with extensive solid solubility in the cubic phases of both cerium and plutonium. No intermediate phases were found. Cerium is soluble in ϵ-plutonium to 16.0 at.% Ce at 626°C and in δ-plutonium to 23.0 at.% at 613°C, decreasing to 17.5 at.% at room temperature. No solubility in the α, β, or γ phases was found, and the minimum cerium required to stabilize δ-plutonium to room temperature was 3.2 at.%. The maximum solubility of plutonium in δ-cerium is 19.5 at.% at 721°C, and the maximum solubility of plutonium in γ-cerium is 34.5 at.%. Invariant points in the system are: eutectic at 626°C, $L_{16.5} \rightleftharpoons \epsilon\ Pu_{16.0} + \gamma\ Ce_{85.5}$; and peritectoid at 613°C, $\epsilon\ Pu_{13.5} + \gamma\ Ce_{66.5} \rightleftharpoons \delta\ Pu_{23.0}$. (auth)

39972 THE THERMAL EXPANSION OF Nb_3Sn(Cb_3Sn). H. W. Schadler, L. M. Osika, G. P. Salvo, and V. J. DeCarlo (General Electric Co., Schenectady, N. Y.). Trans. AIME, 230: 1074-7(Aug. 1964).

The lattice parameter of the intermetallic compound Nb_3Sn was measured as a function of temperature from 80 to 1290°K. The results were compared with published data on the thermal expansion of niobium and indicated

that the compound, when made by diffusion of tin into niobium at 1000°C, would be subjected to a tensile strain of about 0.1% when cooled to room temperature. (auth)

39973 INVESTIGATION OF ROOM-TEMPERATURE SLIP IN ZONE-MELTED TUNGSTEN SINGLE CRYSTALS. R. G. Garlick and H. B. Probst (Lewis Research Center, Cleveland). Trans. AIME, 230: 1120-5(Aug. 1964).

Tungsten single-crystal specimens of various orientations were deformed in tension at room temperature. Slip traces indicated both {112}⟨111⟩ and {110} ⟨111⟩ slip; however, about 10% plastic deformation was required before these traces could be seen. Resolved shear-stress considerations indicated that at least some of the particular systems observed were not those on which slip initiated but were secondary systems. This was concluded to be highly probable, considering the high plastic strains involved. Analysis of the stress data with respect to possible slip systems indicated that slip was initiated at stresses below the proportional-limit stresses measured. (auth)

39974 THE CERIUM–COPPER SYSTEM. T. B. Rhinehammer, D. E. Etter, J. E. Selle, and P. A. Tucker (Monsanto Research Corp., Miamisburg, Ohio). Trans. AIME, 230: 1193-8(Aug. 1964).

The Ce–Cu phase diagram was investigated by differential thermal analysis and metallography. Two congruent melting compounds, $CeCu_2$ (817°C) and $CeCu_6$ (938°C), and three incongruent compounds, CeCu (516°C), $CeCu_4$ (796°C), and $CeCu_5$ (798°C), are presented in this system. Eutectics exist at 28 at.% Cu (424°C), 74 at.% Cu (756°C), and 91 at.% Cu (876°C). The purity of the cerium used had an important effect on the results obtained by differential thermal analysis. (auth)

39975 FATIGUE BEHAVIOR OF HYDROGEN-CHARGED TANTALUM. B. A. Wilcox (Battelle Memorial Inst., Columbus, Ohio). Trans. AIME, 230: 1199-1200(Aug. 1964).

Some evidence that hydrogen can cause fatigue embrittlement of tantalum is presented. A wrought, stress-relieved, arc-melted tantalum rod was charged with hydrogen in an atmosphere of flowing dry hydrogen for 3 hr at 600°C, followed by an anneal in purified argon for 15 min at 600°C. Tension-compression fatigue testing was carried out on both uncharged and hydrogen-charged specimens. Charged specimens at the same alternating stress level as uncharged specimens failed after a considerably lower number of cycles. (M.C.G.)

39976 INVESTIGATION OF EQUILIBRIA IN THE Nb–N SYSTEM. Erich Gebhardt, Eckehard Fromm, and Dieter Jakob (Max-Planck-Institut für Metallforschung, Stuttgart). Z. Metallk., 55: 423-31(Aug. 1964). (In German)

The Nb–N system was investigated up to 30 at.% N on the Nb-rich side and the three dimensional system of pressure, temperature, and concentration constructed. This was derived from equilibrium pressure measurements made during isothermal absorption of nitrogen as well as micrographic and x-ray investigations. The testing temperatures lay between 700 and 2200°C and the pressure between 1×10^{-4} and 10 Torr. In the niobium solid-solution range a relation between equilibrium pressure, nitrogen concentration, and the trace of terminal solubility was found. The minimum nitrogen concentration of the Nb_2N-subnitride phase and the temperature dependence of its decomposition pressure was determined. It was also possible to evaluate some thermodynamic data. (auth)

39977 PROCESSES OF DEGASSING OF NIOBIUM AND TANTALUM. Erich Gebhardt, Eckehard Fromm, and Dieter Jacob (Max-Planck-Institut für Metallforschung, Stuttgart). Z. Metallk., 55: 432-44(Aug. 1964). (In German)

Degassing reactions were studied gravimetrically in the systems Nb–N, Nb–O, and Ta–O in the temperature range 1600 to 2300°C. It was found that nitrogen escapes from niobium in the form of molecular N_2. However, in the systems Nb–O and Ta–O, vaporization of oxides was observed. Since the composition of these oxides is temperature dependent in both Nb–O and Ta–O systems, at least two gaseous oxides must vaporize with different activation energies in both systems. The temperature dependence of "half-way degassification time" for oxygen-containing niobium and tantalum were derived and the activation energies of the degassing processes are given. The temperature dependence of the vapor pressure of gas-free niobium and tantalum was determined. (auth)

39978 STRUCTURE OF THE U_2Co_3Al, U_2OsAl_3 AND UAlMn. Siegfried Steeb and Guenter Petzow (Max-Planck-Institut für Metallforschung, Stuttgart). Z. Metallk., 55: 453-6(Aug. 1964). (In German)

The phases U_2Co_3Al, U_2OsAl_3, and UAlMn were investigated by x rays with the Guinier method. The lattice parameters, densities, and intensities are reported. All three phases are Laves phases of the C14 type ($P6_3/mmc$) in which the B′ and B″ atoms are in statistical distribution in the B positions. The geometrical conditions of the three phases are discussed in relation to other known ternary C14 phases with uranium as the A atom. (auth)

39979 THE PSEUDOBINARY SYSTEM UMn_2–UAl_2. Guenter Petzow and Siegfried Steeb (Max-Planck-Institut für Metallforschung, Stuttgart). Z. Metallk., 55: 456-9 (Aug. 1964). (In German)

The pseudo-binary system of UMn_2–UAl_2 was established by means of metallography, thermal analysis, differential thermo-analysis, and x-ray examinations. A three-phase equilibrium (L = UMn_2 + UAlMn) was formed, which extends from 1 to 18 at.% Al at 1090°C and which has a eutectic point at 16 at.% Al. A peritectic three-phase equilibrium (L + UAl_2 = UAlMn) was discovered with 31 to 51 at.% Al at 1190°C. In medium concentration ranges a ternary Laves-phase of the C14 ($MgZn_2$) type occurred, whose phase region extended from 18 at.% Al at 1090°C to 37 at.% Al at 1190°C. There was nearly no solubility of Al in UMn_2, while AUl_2 took up into solid solution up to 16 at.% Mn under contraction of the unit cell. (auth)

39980 ELECTRON MICROSCOPE STUDIES OF PRECIPITATES AND FISSION DAMAGE IN VAPOUR GROWN UO_2 CRYSTALS. H. Bland and S. Amelinckx (S.C.K.-Centre d'Études de l'Énergie Nucleaire, Mol, Belg.). Z. Metallk., 55: 460-6(Aug. 1964).

Observations were made of defects in UO_2 single crystals, which were grown from the vapor phase. Information was obtained on the precipitation of excess oxygen in UO_{2+x} and on fission-fragment damage in slightly irradiated crystals. (M.C.G.)

39981 METALLURGICAL PROBLEMS IN DEVELOPMENT OF ADVANCED FUEL ELEMENTS. H. Bumm, G. Engelhardt, L. Michael, and H. Sundermann (Kernforschungszentrum, Karlsruhe, Ger.). Z. Metallk., 55: 494-501(Aug. 1964). (In German)

Neither creep tests nor investigation of radiation damage or resistance to corrosion can be used alone, to get reliable information on the suitability of a certain alloy as canning material for fuel elements. Only from the simultaneous effect of the three factors can the suitability of a material

be judged for the working conditions in the reactor. Due to a strong decrease of creep resistance during irradiation the strength of nickel-base alloys after 10,000 hours was not higher than that of the austenitic steels of type 304. However, the corrosion resistance of these alloys was not as high as that of the nickel-base alloys of the type Inconel, but not so low as to exclude use of austenitic steel. Incoloy alloys with the somewhat higher nickel content of 32 to 35 wt % Ni, are homogeneous solid solutions, and therefore reach the corrosion resistance of nickel-base alloys. These alloys and the improved austenitic chromium-nickel steels seemed to be the most promising canning materials. If a dispersion-alloy UO_2–BeO with good heat conductivity is used as nuclear fuel, the pressure on the canning material due to gas evolution will not increase to high values even after much burnup, as was the case for pure UO_2 ceramics. The smaller mechanical load on the canning tubes makes the choice of the canning material easier. (auth)

39982 THE ROLE OF THE COHERENCE LENGTH IN THE SUPERCONDUCTING TRANSITION. B. B. Goodman. Chap. 22 of "Metallic Solid Metals." New York, W. A. Benjamin, Inc., 1963.

The effects of the coherence length on the superconducting transition temperature in zero magnetic field were investigated. The connection between the surface energy and the coherence length was also studied. The various models that purport to explain the role of the coherence length in super-conducting transition are discussed. (Rev. Metal Lit., 21: No. 7, July 1964)

39983 EFFECTS OF NONMAGNETIC IMPURITIES IN SUPERCONDUCTING ALLOYS. C. Caroli, P. G. de Gennes, and J. Matricon. Chap. 23 of "Metallic Solid Metals." New York, W. A. Benjamin, Inc., 1963.

Some effects of electron scattering by impurities in superconducting alloys were calculated. At very small impurity concentrations, the major phenomenon is the destruction of the anisotropy in the energy gap. This is computed in detail for a simple model. In the dirty-superconductor range the first approximation replaces the order parameter by its space average. Results show that local variations of order parameter can be taken into account by an iteration process; they are important for impurities that are very different in charge from the matrix. They can also be studied in the vicinity of the free surface of a pure superconductor: This gives a better understanding of the boundary conditions to be applied at the Landau-Ginsburg equations. (Rev. Metal Lit., 21: No. 7, July 1964)

39984 EFFECT OF TEMPERATURE ON THE STRENGTH OF POWDER-METAL MATERIALS IN THE RANGE 20–2800°C. V. K. Kharchenko. p.16-22 of "Sbornik, Voprosy Vysokotemperaturnoi Prochnosti v Mashinostroenii." Kiev, Academy of Sciences, 1963.

Titanium carbide, molybdenum carbide, tungsten carbide, zirconium boride, and silicon nitride were investigated. After sintering the specimens had an average porosity of 20–25%. Bend tests were conducted in argon. Loading rate was 10 mm/min (approximately 0.4 kg/mm^2 sec). Direct passage of current through a sample, as well as the use of graphite heating elements heated the samples. For the investigated materials the data spread of separate tests at one temperature is of the order of 20–35%. The strength of TiC, Mo_2C, and WC varied little with a temperature increase from 1200–1300°C. For further temperature increases (for each of the materials this temperature was somewhat different) strength sharply increases and reaches a specific maxima. Maximum bend strength for TiC, Mo_2C, and WC was dependent on temperature and equal to 0.6 T melting. (Referativnyy Zhurnal, 48, No. 4, Apr. 1964)

39985 NIOBIUM HARDNESS AT 20–2120°C. V. A. Borisenko. p.31-5 of "Sbnornik, Voprosy Vysokotemperaturnoi Prochnosti v Mashinostroenii." Kiev, Academy of Sciences, 1963.

Niobium specimens obtained by the method of powder metallurgy, and cast niobium after single electron-beam remelting were investigated. Hardness was measured in the temperature range 20–1760°C by static impression with a sapphire pyramid. The hardness of niobium powder throughout almost the entire range of temperatures is higher than the hardness of cast niobium. Increasing the test temperature from 20 to 300°C was accompanied by a sharp decrease in the hardness of powdered and cast niobium. At temperatures above 1350°C the hardness of powdered and cast niobium is the same. (Referativnyy Zhurnal, 48, No. 4, Apr. 1964)

39986 LONG-TIME HARDNESS OF MOLYBDENUM AT HIGH TEMPERATURES. V. A. Borisenko. p.121-5 of "Sbornik, Voprosy Vysokotemperaturnoi Prochnosti v Mashinostroenii." Kiev, Academy of Sciences, 1963.

The long-time hardness of cold-worked MRN molybdenum was investigated at temperatures of 20, 940, 1310, and 1600°C. Long-time hardness was determined in purified helium by the static impression with a sapphire pyramid. Loading was maintained on a specimen from 10 seconds to 1 hour. Specific long-time hardness of molybdenum in H–τ (min) coordinates follows straight lines. Three hot-hardness tests, for which the holding time under load in each successive test increases 10 times (30 sec, 5 and 50 min), were adequate to obtain the characteristics of long-time hardness. (Referativnyy Zhurnal, 48, No. 4, Apr. 1964)

Radiation Effects

Refer also to abstracts 39567, 39579, 40807, and 40835.

39987 (AAEC/E-124) THE IRRADIATION BEHAVIOUR OF COLD-PRESSED AND SINTERED BERYLLIUM OXIDE DISPERSION FUELS. G. L. Hanna and R. J. Hilditch (Australia. Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales). June 1964. 18p.

Coarse and fine dispersions of $(U,Th)O_2$ in BeO, prepared by cold-pressing and sintering, were exposed to fission fragment damage by irradiation in a thermalized neutron flux. Irradiation temperatures were at 610 to 720°C and fission densities of 3×10^{19} to 2×10^{20} fission per cm^3 of compact were achieved. The dimensional stability of all specimens was very good and the greatest volume expansion was 1%. Estimated thermal stresses ranged up to 32,000 psi but no thermal stress failure occurred. The fine and the most dilute coarse dispersions released only 0.1% of the fission gases but the remaining coarse dispersions released from 0.6 to 4.9%. Coarse fuel particles were generally cracked after irradiation and, by microscopy, fission fragment damage to the fuel–BeO interfaces was observed in the high burnup specimens. Fission gas bubbles developed in coarse fuel particles on post-irradiation annealing at 1250 and 1500°C. (auth)

39988 (BMI-X-290) EXPERIMENTAL TECHNIQUES USED IN VACUUM IRRADIATIONS OF ELECTRONIC COMPONENTS AT 150 F. Sam J. Basham, J. H. Stang, W. G. Rieder, B. P. Fairand, and H. T. Gruber (Battelle Memorial Inst., Columbus, Ohio). Sept. 4, 1964. Contract W-7405-eng-92. 57p.

A series of five groups of SNAP program electronic components were irradiated at approximately 150°F in a high-vacuum system at the Battelle Research Reactor. The design and operation of the experimental apparatus are described and dosimetry procedures and data are given. Three assemblies which contained electronic components (diodes, capacitors, transistors, etc.) were irradiated about 200 hr, during which fast-neutron (>0.1 Mev) exposures of about 10^{18} n/cm^2 were accumulated. Two groups of electromechanical devices (switches, relays, detectors, amplifiers, power supplies, etc.) were irradiated about 100-150 hr to fast-neutron (>0.1 Mev) exposures of about 10^{14} n/cm^2. Specimen parameters were measured periodically during the experiments to determine damage thresholds and degradation rates. (auth)

39989 (BNL-7696) THE EFFECT OF IRON VACANCIES ON THE DIFFUSION OF INTERSTITIAL CARBON IN Fe–C ALLOYS. A. C. Damask (Brookhaven National Lab., Upton, N. Y.; Frankford Arsenal. Pitman-Dunn Lab., Philadelphia); and R. A. Arndt (Brookhaven National Lab., Upton, N. Y.). [1963]. Contract AT-30-2-GEN-16. 20p. (CONF-489-4)

From 5th International Symposium on the Reactivity of Solids, Munich, Aug. 1964.

The effects of neutron irradiation on C–Fe alloys in which the solute is in interstitial positions were studied by internal friction, electric resistivity, electron microscopy, and calorimetry. The mechanisms of damage-associated site creation for nucleation of the precipitates and the effects of neutron-induced lattice vacancies which serve as traps for the diffusing interstitial solute atoms and thereby retard precipitation of the solute are examined. (J.R.D.)

39990 (CRFD-1178) ZIRCALOY-2 CLAD UO_2 FUEL ELEMENTS IRRADIATED TO A BURNUP OF 10,000 MWd/Tonne U. R. D. MacDonald and G. W. Parry (Atomic Energy of Canada Ltd., Chalk River, Ont.). Jan. 1964. 49p. (EXP-NRX-2906; AECL-1952)

Ten Zircaloy-2-sheathed uranium oxide elements were irradiated to a maximum burnup of 10,000 Mwd/t U in the pressurized water loops of the NRX reactor. All elements were intact at the finish of the test except for one specimen where corrosion of a small inclusion in the top weld bead caused failure. Final dimensions of the elements were almost unchanged from the pre-irradiation measurements; however, most diameters had expanded by as much as 0.003 in. midway through the test when the heat outputs of the elements were at their highest. The extent of discernible grain growth in the UO_2 was consistent with results from other Chalk River fuel of nearly identical density. More fission gas was released from the X-2-t elements than from similar fuel irradiated at the same average heat ratings. The ZrO_2 film was thicker and the percent hydrogen up-take was smaller than for unirradiated Zircaloy-2 exposed in autoclaves. The ultimate tensile strength of the irradiated Zircaloy had increased 33%, while the ductility of the material was reduced. (auth)

39991 (D2-90407) CORRELATION OF PROTON TO NEUTRON AND ELECTRON TO PHOTON RADIATION DAMAGE IN TRANSISTORS AND DIODES. G. L. Keister (Boeing Co., Seattle). Apr. 22, 1963. 21p. (AD-437754; CONF-664-1)

From American Society for Testing Materials Symposium on Radiation Effects in Space, Atlantic City, N. J., June 1963.

Work on radiation damage in semiconductor devices is reviewed with respect to the radiation problem in equipment for space applications. The possible correlation or equivalence of radiation damage as a means of simplifying the radiation damage picture is considered, and evidence for such equivalence is discussed. Recommendations are given for the development of radiation-hardened equipment for space systems. (D.L.C.)

39992 (EUR-1643.e(p.231-45)) THE EFFECT OF LATTICE IMPERFECTIONS ON THE INTENSITIES DIFFRACTED BY NEARLY PERFECT CRYSTALS. R. Colella, A. Merlini, S. Pace, and E. van der Voort (European Atomic Energy Community. Joint Nuclear Research Center, Ispra, Italy).

Experimental and theoretical results are given for quantitative measurements of intensities of x rays diffracted by almost perfect crystals. The variation with temperature can be accounted for by the Debye-Waller factor exp(-M), as expected. Experimental data are presented on germanium and silicon irradiated with fast neutrons, germanium irradiated with alpha particles, and silicon doped with boron. A semiclassical treatment shows that the angle dependence of the imaginary part of the atomic scattering factor is very small. (auth)

39993 (EUR-1643.e(p.246-53)) ENHANCEMENT OF DIFFUSION DURING IRRADIATION. W. Schuele (European Atomic Energy Community. Joint Nuclear Research Center, Ispra, Italy).

Comparison between the theory and the experiments shows that a steady-state concentration of interstitials and vacancies is obtained during the irradiation of metals and alloys at temperatures for which interstitials are mobile. In copper–aluminum and copper–zinc alloys, both interstitials and vacancies can change sites with both components of the alloy. The migration energy of interstitials in these alloys is 0.80 ev. (auth)

39994 (EURAEC-1157) INFLUENCE OF NITROGEN IN IRON AND STEEL UNDER FAST NEUTRON IRRADIATION. Technical Report No. 1 on STUDY THROUGH MAGNETIC PROPERTIES CHANGES OF FAST NEUTRON IRRADIATION EFFECTS IN HIGH-PURITY IRON. A. Ferro, G. Montalenti, G. P. Soardo (Italy. Istituto Elettrotecnico Nazionale "Galileo Ferraris," Turin), and F. Rossi (Società Ricerche Impianti Nucleari. Centro Ricerche Nucleari, Saluggia, Italy). June 1964. Work Performed under United States–Euratom Joint Research and Development Program. Contract 004-63-10-TEEI (RD). 55p.

A group of experiments is reported on the changes of magnetic properties of very high purity iron irradiated with fast neutrons. The maximum permeability of specimen is of the order of 150,000–200,000. The C and N content was about or less than 2 ppm. The irradiation was done in the SORIN RS1 Reactor. The specimens have been irradiated under magnetic field instead of being demagnetized before irradiation as in previous experiments. This was aimed to better explain the nature and form of defects induced by irradiation. The results show that the changes of magnetic properties produced by the radiation are sensitive to an applied magnetic field. This proves that the induced defects have a definitive form anisotropy. (auth)

39995 (GA-3087) DISPLACEMENT RADIATION EFFECTS. Final Report. E. G. Wikner, H. Horiye, J. W. Harrity, and V. A. J. van Lint (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Apr. 16, 1962. Contract DA-49-186-ORD-822. 74p. (AD-440293)

The purpose of this experimental program was to study the effect of irradiation on semiconductor materials and types of defects formed by various kinds of irradiation. Irradiation by electrons with energies between 5 and 45 Mev using the linear accelerator and neutron bombardments done with the TRIGA reactor were used to study the electrical properties of germanium, silicon, and tellurium as a function of irradiation at 80°K. Properties studied were the conductivity, Hall effect, and minority carrier lifetime. The carrier removal rates obtained for electron bombardment at energies of 5, 15, and 45 Mev on 0.5 ohm-cm n-type Ge were 2.4, 3.6, and 4.8 per cm. Annealing studies were performed between 78 and 350°K after irradiation. The annealing behavior of n-type Ge and n-type Si was dependent on the amount of radiation the sample received and the type of donor impurity present in the sample initially. (auth)

39996 (HW-79793) MEASURING AND CORRELATING NEUTRON EXPOSURE AND DAMAGE IN GRAPHITE. R. E. Dahl (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Dec. 1963. Contract AT(45-1)-1350. 21p.

Methods for predicting the service performance of graphite when the test-reactor environment differs from actual or anticipated environments are described. The methods are applicable to other materials that are damaged by atomic displacements caused by irradiation. (J.R.D.)

39997 (HW-82263) METALLIC URANIUM IN IRRADIATED UO_2. J. L. Bates (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). May 1964. Contract AT(45-1)-1350. 27p.

The presence, the identification, and the distribution of metallic uranium in UO_2 fuel elements irradiated at high temperatures were investigated. A wide variety of UO_2 fuel systems have been intensively examined for uranium by metallographic and x-ray-diffraction techniques. Uranium metal is found in all fuel elements irradiated with central temperatures high enough to cause extensive grain growth. (auth)

39998 (HW-SA-3673) IRRADIATION BEHAVIOR OF HIGH-PURITY URANIUM. R. D. Leggett, B. Mastel, and T. K. Bierlein (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Aug. 11, 1964. Contract AT(45-1)-1350. 13p. (CONF-668-1)

For Presentation at Electron Microscope Society of America 22nd Annual Meeting, Detroit, Mich., Oct. 1964.

The irradiation behavior of small, high-purity U samples irradiated under controlled conditions is described. Results of the study in which the behavior was observed serve as a basis for future evaluation of the role of small amounts of alloying additions, external restraints such as cladding, and internal restraints such as geometry. (J.R.D.)

39999 (KAPL-2251) EFFECTS OF IRRADIATION ON THE OMEGA PHASE IN ZIRCONIUM–NIOBIUM ALLOYS. B. S. Shabel and F. W. Kunz (Knolls Atomic Power Lab., Schenectady, N. Y.). May 15, 1964. Contract W-31-109-eng-52. 26p.

Zirconium- and Zircaloy-2-based alloys containing niobium and vanadium were irradiated to ~0.9 to 1.2×10^{20} neutrons/cm^2 (>1 Mev) at ~250°C after various annealing treatments. Examination by hardness and x-ray diffraction techniques revealed that irradiation produced definite structural changes. Alloys containing residual β-zirconium experienced the equivalent of thermal aging at temperatures >250°C: the β-zirconium decomposed to form β' and aged-ω structures. Alloys containing β' and/or β-niobium plus α-zirconium structures, however, underwent an apparent phase reversion. Here, it is hypothesized: the α-zirconium transformed to β-zirconium, the latter then decomposing to the β' and aged-ω phases. (auth)

40000 (NARF-63-11T) EFFECTS OF REACTOR RADIATION ON A CERAMIC-BONDED, A RESIN-BONDED, AND A METAL-MATRIX-BONDED SOLID-FILM LUBRICANTS. R. H. McDaniel (General Dynamics/Fort Worth. Div. of General Dynamics Corp., Fort Worth, Tex.). Mar. 31, 1964. Contract AF33(657)-7201. 26p. (MR-N-306; AD-603442)

Three solid-film lubricant formulations— PbS + MoS_2 + B_2O_3, GD/FW Dynalube, and Almasol SFD-560—have been exposed to reactor radiation and tested for wear life on a Hohman A-6 wear tester. Rub shoes were of Rex AAA steel, load per shoe was 110 lb, and sliding speed was 128 ft/min. Substrate materials were T-1 tool steel for GD/FW Dynalube and Timken standard test races (T-54148-3-233) for the other two lubricants. Several test temperatures up to 1150°F were employed. The solid-film lubricant specimens received an average radiation exposure of 1.7×10^{11} ergs/gm(C) of gammas and 3.7×10^{16} n/cm^2 (E > 2.9 Mev) of neutrons. Significant decreases in wear life occurred at 80° and 900°F for Dynalube and at 900°F for SFD-560; PbS + MoS_2 + B_2O_2 showed no change; and SFD-560 improved markedly at 80°F. (auth)

40001 (NARF-63-17T) EFFECTS OF REACTOR RADIATION ON MIX-BIS (MIX-PHENOXYPHENOXY) BENZENE USED AS A LUBRICANT IN A HIGH-SPEED, HIGH-TEMPERATURE BEARING-RIG. W. M. Laney, R. H. McDaniel, M. R. Self, and J. H. Lewis (General Dynamics/Fort Worth. Div. of General Dynamics Corp., Fort Worth, Tex.). Mar. 31, 1964. Contract AF33(657)-7201. 85p. (FZK-9-193; AD-603444)

A radiation effects study has been conducted on mix-bis (mix-phenoxyphenoxy) benzene–Mixed 5P4E–used as a high-speed bearing lubricant at elevated temperatures. This study, which included evaluations of selected antioxidants in Mixed 5P4E, employed a modified Shell high-speed, high-temperature, ball-bearing rig and the Ground Test Reactor at General Dynamics/Fort Worth. Bearing and bulk-oil test temperatures of 550, 600, and 700°F were employed with axial bearing load of 200 lb at 60,000 rpm during control and test runs. It was concluded that a gamma dose of 2×10^{10} ergs/gm(C) plus associated neutrons is approaching the useful upper limit for Mixed 5P4E as a high-speed bearing lubricant at temperatures of from 550 to 600°F. At 700°F this limit is decreased by approximately one order of magnitude. A 0.5% concentration of the antioxidant tetraphenyltin in Mixed 5P4E appeared to improve bearing-rig performance under irradiation. (auth)

40002 (NARF-63-19T) EFFECTS OF NUCLEAR RADIATION ON THE MECHANICAL, OPTICAL AND ELECTRICAL PROPERTIES OF MERLON POLYCARBONATE. E. G. Fritz (General Dynamics/Fort Worth. Div. of General Dynamics Corp., Fort Worth, Tex.). Mar. 3, 1964. Contract AF33(657)-7201. 56p. (FZK-9-195; AD-603445)

Merlon polycarbonate was exposed in a nuclear reactor

at room temperature in air to five levels of absorbed dose: 3.07×10^8, 6.8×10^8, 1.53×10^9, 3.83×10^9, and 1.18×10^{10} ergs/gm(C). The material showed an excellent postirradiation retention of various mechanical properties. No significant changes in ultimate tensile strength and Shore-D hardness were observed up to an absorbed dose of 1.53×10^9 ergs/gm(C). The yield stress, however, was found to decrease steadily with dose. At about 1×10^{10} ergs/gm(C), no yielding was observed any longer and the mode of fracture had changed from ductile to brittle behavior. The G-value for radiation-induced scission was calculated on the basis of the heat of necking to be 0.18 scissions/100 ev. The apparent optical density of the samples at the OH-absorption peak at 2760 mμ was determined to be a linear function of the logarithm of absorbed dose. All irradiated samples assumed a brownish discoloration the intensity of which progressively increased with dose. No significant changes in the dc volume and surface resistivity were noted. The results of the present study are compared with the findings of other investigators. (auth)

40003 (NRL-6127) IN-REACTOR STUDIES OF LOW-CYCLE FATIGUE PROPERTIES OF A NUCLEAR PRESSURE VESSEL STEEL. J. R. Hawthorne and L. E. Steele (Naval Research Lab., Washington, D. C.). June 2, 1964. Contract AT(49-5)-2110. 18p.

An experimental irradiation assembly and associated instrumentation which have been developed and successfully utilized for the performance of dynamic in-reactor low cycle fatigue tests of reactor pressure vessel steels are described. The equipment provides for the simultaneous reverse bend testing of as many as fifteen sheet type specimens representing a range of strain amplitudes at controlled temperatures in the range 300 to 700°F. The results of an exploratory investigation on the fatigue resistance of ASTM type A302-B steel during irradiation at 500°F are presented and compared with data from out-of-reactor control tests. These preliminary data do not indicate any pronounced difference in the fatigue strength of irradiated versus unirradiated steel. Exploratory investigations are continuing. (auth)

40004 (NRL-Memo-1502) EFFECTS OF NEUTRON IRRADIATION ON THE PROPERTIES OF REACTOR STRUCTURAL MATERIALS. L. E. Steele, J. R. Hawthorne, and C. Z. Serpan, Jr. (Naval Research Lab., Washington, D. C.). Jan. 20, 1964. Contract AT(49-5)-2110. 18p. (AD-433152)

Significant accomplishments in the calendar year 1963 for four areas of research are summarized. These include: (1) The determination of high energy neutron exposure to reactor pressure vessels utilizing the ^{54}Mn isotope analysis; (2) the evaluation of various steels in terms of radiation sensitivity; (3) the assessment of the effects of nuclear environmental conditions and service stress conditions as factors in irradiated steel behavior; and (4) determination of the influence of thermal environment (during and after irradiation) on the neutron embrittlement of reactor steels. (auth)

40005 (ONR-16(Vol.1)(p.246-62)) IN-PILE HALL ELECTRON TRANSPORT PROPERTY MEASUREMENTS ON ZONE-REFINED, P-TYPE SILICON. G. C. Bailey and C. M. Williams (Naval Research Lab., Washington, D. C.).

The variations in the Hall coefficient and the conductivity of zone-refined silicon undergoing neutron irradiation are similar to those of pulled silicon except that the changes with integrated flux occur much more rapidly for the zone-refined material. The log of the conductivity shows a monotonic, non-linear decrease with irradiation for the 100 ohm-cm samples, a single region of linear decrease for the 8 ohm-cm sample, and two regions of linear decrease for the 1 ohm-cm sample. For the latter sample, this effect is attributed partly to the filling of the levels which may involve oxygen atoms in some way. The initial hole removal rates are 80, 60, and 20 cm^{-1} for the 1, 8, and 100 ohm-cm samples, respectively, at an irradiation temperature of 100°C, and 115 cm^{-1} for one of the 100 ohm-cm samples at an irradiation temperature of 72°C. The Hall coefficient goes through a maximum and decreases for the 8 and 100 ohm-cm samples and then goes through zero and becomes negative for the 100 ohm-cm samples. In the case of the 1 ohm-cm sample, the Hall coefficient increases and then levels off. The Hall mobility decrease in the 8 and 100 ohm-cm samples is ascribed to a decrease in the carrier density. The Hall mobility is constant with irradiation for the 1 ohm-cm sample. (auth)

40006 (REIC-34) RADIATION-EFFECTS STATE OF THE ART, 1963–1964. (Battelle Memorial Inst. Radiation Effects Information Center, Columbus, Ohio). June 30, 1964. Contract AF33(615)-1124. 116p. (AD-603708)

Progress is summarized and problem areas are reviewed in the radiation effects field. Among the areas covered are: electronic components and equipment (including semiconductors); polymeric materials; lubricants, flotation, and hydraulic fluids; ceramics; space radiation environment; dosimetry; and structural metals and alloys. The operations and publications of the Radiation Effects Information Center are also reported. (D.L.C.)

40007 (REIC-ACCESS-77) RADIATION EFFECTS INFORMATION CENTER MONTHLY ACCESSION LIST. Period Covered: July 1, 1964–July 31, 1964. Abstract No. 24527 to 24600. (Battelle Memorial Inst. Radiation Effects Information Center, Columbus, Ohio). Aug. 10, 1964. 27p. (AD-603689)

Presented are 74 abstracts of articles accessioned and extracted for the REIC Technical Information File. The abstracts are arranged under the following headings: metallic materials, ceramic materials, organic materials, polymeric materials, inorganic materials, electronic materials and equipment, facilities, space environment and effects, experimental devices and techniques, and miscellaneous. (D.L.C.)

40008 (SWRI-1228-30) MODIFIED SURVEILLANCE PROGRAM FOR THE ELK RIVER REACTOR PRESSURE VESSEL STEELS AND WELDMENTS. Topical Report No. 1. Robert D. Wylie, A. L. Lowenberg, J. McDonald, Jr., and P. D. Watson (Southwest Research Inst., San Antonio). Aug. 14, 1964. Contract AT(11-1)-1228. 142p.

The scope of the Elk River Reactor Pressure Vessel Surveillance Program was expanded to include a study of the effects of neutron irradiation on the low-cycle plastic fatigue strength of the pressure vessel steels and weldments. This modification is a part of a larger program to provide technical basis for relaxation of the 250-cycle limitation presently imposed on the vessel. The ERR surveillance capsule design was modified to permit the maximum number of fatigue specimens to be encapsulated. A total of sixteen modified capsules were fabricated. A schedule for the removal and insertion of both the original and the modified capsules was prepared. The ten-year exposure interval corresponds to a vessel life of twenty years since the surveillance capsules are lo-

cated on the core-side of the thermal shield and receive twice the neutron irradiation received by the pressure vessel. Predictions of the in-service shifts in the nil-ductility transition temperature (ΔTT) of the vessel steels due to fast neutron irradiation (energy >1 Mev) will be based on post-irradiation impact tests of Charpy V-Notch specimens representing three heats of A302 Grade B steels, two heats of A105 Grade II steels, and one heat of A212 Grade B steel (control specimens). Neither the original surveillance program impact specimens nor the additional impact specimens to be irradiated are from the same heats as the vessel. (auth)

40009 (UCRL-7810) BIBLIOGRAPHY [ON] RADIATION EFFECTS ON NOBLE METALS. Brigitta M. Dobratz (California. Univ., Livermore. Lawrence Radiation Lab.). Apr. 14, 1964. Contract W-7405-eng-48. 31p.

A total of 173 references is presented on radiation effects on noble metals with particular emphasis on Cu, Au, Pt, and Ag. They cover the open literature from 1958 to 1963. An author index is provided. (D.L.C.)

40010 (USAELRDL-TR-2323) NEUTRON AND GAMMA RADIATION EFFECTS ON DIELECTRICS. Erik G. Linden and Charles P. Lascaro (Army Electronics Research and Development Lab., Fort Monmouth, N. J.). Jan. 1963. 22p.

Dielectrics such as asbestos-fabric phenolic, asbestos-filled phenolic, asbestos-filled diallyl phthalate, mica-filled phenolic, alumina, forsterite, paper-phenolic laminate, polystyrene, polytetrafluoroethylene, and polyethylene were exposed to pulsed fast neutrons, ranging from 1.63×10^{12} to 2.0×10^{12} nvt, and to gamma radiation at the rate of 2.8×10^{4} r/hr up to a total dose of 5.88×10^{5} r. Results indicate that the exposures have no significant permanent aftereffects on dielectric constant and dissipation factor, measured at 60 cps, 1 mcs, and 30 mcs, nor on d-c volume resistivity, nor on d-c and 60 cps surface resistivity of these dielectrics. (auth)

40011 (JPRS-26001) RADIATION RESISTANCE OF PLASTIC MATERIALS. Translated from p.35-44; 80-92 of "Zashchitnye Pokrytiya v Atomnoii Tekhnike," Moscow, 1963. 27p. (TT-64-41272)

Two articles are presented which respectively treat the radiation resistance of PVC materials with additives and an adhesive for gluing plastics to building surfaces. Separate abstracts were prepared for both articles. (D.L.C.)

For abstracts of individual papers see: 39408 and 40012.

40012 (JPRS-26001(p.1-10)) THE RADIATION RESISTANCE OF POLYVINYLCHLORIDE AND POLYMERIC MATERIALS BASED ON IT. M. N. Shteding. Translated from p.35-44 of "Zashchitnye Pokrytiya v Atomnoii Tekhnike," Moscow, 1963.

The effects of anti-radiation and stabilizing-inhibiting additives on PVC were studied under conditions of gamma-radiation. The theoretical possibility of raising the radiation-resistance level of polymeric materials based on PVC and the expedience of introducing special additives—anti-radiation agents and stabilizer-inhibitors—in combination with the ordinary industrial stabilizer-inhibitors into standard plastic blends and articles are discussed. (auth)

40013 SOME REGULARITIES IN THE VARIATION OF THE RAMAN SPECTRUM OF α-QUARTZ WHEN IRRADIATED BY FAST NEUTRONS. V. G. Zubov and L. P. Osipova (Moscow State Univ.). Dokl. Akad. Nauk SSSR, 156: 300-1(May 11, 1964). (In Russian)

A DFC-12 spectrometer was used in an investigation of combined scattering by α-quartz after irradiation with 7×10^{19} n/cm^2. It was found that the combined spectrum differed from the spectrum of quartz previously irradiated with $(4 \text{ to } 5) \times 10^{19}$ n/cm^2. The spectrum of quartz irradiated by $(4 \text{ to } 5) \times 10^{19}$ n/cm^2 retained the basic properties of nonirradiated quartz, while that of the specimen irradiated with 7×10^{19} n/cm^2 differs in the number maxima and their frequencies especially, in the region to 600 cm^{-1}. Comparative analysis of the combined scattering spectra of irradiated and nonirradiated quartz showed that the changes in basic spectral parameters induced by fast neutrons are similar to those induced by temperature. An integral flux of $(6 \text{ to } 7) \times 10^{19}$ n/cm^2 is equivalent to the temperature of $\alpha - \beta$ phase transition. (R.V.J.)

40014 THE INFLUENCE OF γ-RADIATION ON THE RATE OF AGING OF BERYLLIUM BRONZE. L. N. Bystrov and L. I. Ivanov. Dokl. Akad. Nauk SSSR, 157: 147-9(July 1, 1964). (In Russian)

The effect of ^{60}Co γ irradiation on the aging process in a Cu alloy containing 2.5% Be, quenched from 800°C in water, was determined by measuring the change in relative electric resistance $\Delta(R_{irr.}/R_{unirrad.})$. The measurements were made at liquid nitrogen temperatures (−196°C) in order to decrease the phonon component of the electric resistance. On attaining an integral irradiation dose of 125×10^{7} R, the irradiated sample and the control sample were annealed under identical conditions at a temperature of 120°C. The control sample showed no aging at room temperature, but did undergo aging at 120°C with a monotonic increase in the electric resistance. The irradiated sample showed a linear increase in the electric resistance with increasing irradiation dose with an increase of 0.7% in the electric resistance at a maximum dose of 125×10^{7} R. Then, on annealing the irradiated sample, the relative electric resistance increased sharply by ~1.3% after 80 to 100 minutes of annealing at 120°C. Then, further annealing led to a slow decrease in the relative electric resistance. The thermal aging of the irradiated sample went faster than the unirradiated control sample. (TTT)

40015 PHOTOCONDUCTIVITY OF PHOTOPLASTICS-3 STIMULATED BY X IRRADIATION. F. F. Kodzhespirov, F. I. Kolomoitsev, and A. Ya. Yakunin (Dnepropetrovsk State Univ., USSR). Izv. Vysshikh Uchebn. Zavedenii, Fiz., No. 2, 142-6(1964). (In Russian)

The properties of photoplastic-3 were studied as functions of temperature, electric field, and radiation intensity. The measurements were carried out in a vacuum of 5×10^{-5} mm Hg on 25-mm disc shaped specimens. The specimens were placed in positions that permitted both irradiation and illumination. In thick specimens the current rapidly increased reaching a maximum and then slowly dropped to a stationary point that was several tens to a hundred times the dark current. The increased electric conductivity during illumination resulted from the release of charges that had been captured after x-ray stripping. (R.V.J.)

40016 EFFECTS OF X RADIATION ON THE PROPERTIES OF POINT CONTACT GERMANIUM DIODES. Z. Ya. Kleiman and T. A. Slefanova (Dzerzhinski Military Engineering Academy, USSR). Izv. Vysshikh Uchebn. Zavedenii, Fiz., No. 2, 160-5(1964). (In Russian)

Effects of x radiation on p-n germanium point diodes, were investigated. A considerable increase of the reverse

current was observed during irradiation. It is shown that the photoelectric increment of reverse current is a linear function of radiation intensity. (tr-auth)

40017 EFFECTS OF GAMMA RADIATION ON MAGNETIC RESISTANCE OF ALKALI SILICATE GLASS. L. M. Belyavskaya and N. V. Terent'eva (Tomsk State Univ., Siberian SSR). Izv. Vysshikh Uchebn. Zavedenii, Fiz., No. 2, 169-70(1964). (In Russian)

Effects of γ radiation on the electric conductivity of alkali silicate glass in magnetic fields were studied using 2 × 5 mm 0.5 to 1 mm thick plates. The electric conductivity of specimens exposed to 10^6 to 10^7 R at room temperature varied from the original by 5 to 20%, depending on the Na_2O content. The effect was not a function of magnetic field direction, and the conductivity returned to normal when the field was reduced to zero. Tests with specimens containing 12.5 and 50 mole % Na_2O exhibited considerably larger and more permanent changes. The same conductivity effects were observed in technical glass. It is postulated that the conductivity changes in irradiated glass result from interactions of two current carriers in the electric and magnetic fields. The resistance increases and decreases depending on carrier sign and field intensity relations. (R.V.J.)

40018 EFFECTS OF NEUTRON IRRADIATION AT 250°C ON THE TENSILE AND IMPACT PROPERTIES OF A 1% Cr–0.5% Mo PRESSURE VESSEL STEEL. D. R. Harries, G. H. Wooldridge, and I. H. McWilliam (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Iron Steel Inst. (London), 202: 448-53(1964).

Tensile and Charpy V-notch specimens machined from the parent material and weld metal of a welded portion of a 1% Cr–0.5% Mo pressure vessel steel forging were irradiated at 250°C in the PLUTO reactor. The changes in room-temperature tensile properties and impact transition temperatures of the parent material specimens are roughly proportional to the square root of the fission neutron dose in the range $1.48–35.4 \times 10^{18}$ n cm^{-2}. The weld metal tensile and impact specimens irradiated to 1.49 and 1.78×10^{18} n cm^{-2} (fission), respectively showed somewhat smaller changes in properties compared with the parent material samples irradiated to the same dose. (auth)

40019 NEUTRON RADIATION EFFECTS ON MECHANICAL PROPERTIES OF METAL STRUCTURAL MATERIALS. Miroslav Vacek (Inst. of Nuclear Research, Cacechoslovak Academy of Sciences, Rez). Jaderna Energie, 10: 231-42(1964). (In Czech)

Problems and the results of an investigation of radiation damage of some nuclear reactor structural materials from the point of view of basic mechanical properties are discussed. A short review of the theory of radiation damage of non-fissionable metals is included. A brief description of some results of direct visual investigation of radiation damage of non-fissionable metals by means of a transmission electron microscope is given as well. Special attention is given to the direct effects of neutron radiation on the strength and increased tendency to brittle fracture. Radiation damage recovery problems and further intention of the investigation of radiation-induced mechanical changes of structural materials are also discussed. (auth)

40020 THE INFLUENCE OF NEUTRON IRRADIATION OF THE DESIGN AND OPERATION OF REACTOR VESSELS. D. Knoedler and K. Schaller (Siemens-Schuckertwerke AG, Erlagen, Ger.). Kerntechnik, 6: 339-43(July-Aug. 1964). (In German)

A design approach for reactor pressure vessels is outlined, which considers neutron embrittlement of steels. The procedure gives reliable predictions about permissible combinations of stress levels and temperatures in a pressure vessel as a function of neutron flux, in addition to stress analysis. The conditions leading to brittle fracture; the relations between laboratory fracture testing, acceptance tests, and service behavior; neutron effects on the mechanical properties of low alloy steels; and assumptions for safety are reviewed as background for the approach. (D.C.W.)

40021 PROPERTIES AND UTILIZATION OF RUBBER REGENERATED BY RADIATION. W. Zielinski. Magy. Kem. Lapja, 19: 300-2(June 1964). (In Hungarian)

The investigations demonstrated that changes can be induced in waste rubber products under the influence of gamma radiation, making possible the manufacture of a valuable regenerate by a simplified process. It can come to industrial realization of the problem, supposing that it should go through to use cheap gamma energy sources, e.g. from used up fission plates of nuclear reactors. (auth)

40022 DIELECTRIC PHENOMENA OF BERYL AND CORDIERITE AND THE RADIATION EFFECT ON THEM IN BERYL. Ryoiti Kiriyama and Shichio Kawai (Osaka Univ.). Mem. Inst. Sci. Ind. Res. Osaka Univ., 21: 111-20 (1964).

Dielectric dispersion of quartz at high temperatures is discussed from the standpoint of the role of water molecules trapped in lattice defects. On the basis of the x and γ irradiation on dielectric relaxation phenomena, it was concluded that trapped water molecules are dissociated to H^+ and OH^- by x rays and some sort of local lattice distortion might occur after γ irradiation. Further studies were conducted on beryl and cordierite, the crystal structures of which are similar to that of quartz with respect to their open channels containing some impurity ions or molecules. Thus a study of inclusion impurities, such as water molecules, hydroxyl ions, and alkali ions, accommodated within the open structure was made in beryl and in cordierite by measuring dielectric absorption. Dielectric dispersion of beryl was observed in the audio frequency region at temperatures higher than 350°C with the electric field parallel and perpendicular to the c axis respectively. The activation energy for the dielectric relaxation was about 28 kcal/mole. In cordierite, two kinds of dielectric dispersion, centered around 150° and 450°C, were observed at audio frequencies. The activation energies were about 14 kcal/mole and 25 to 30 kcal/mole respectively. The shift of f_{max} after x and γ irradiation, at which maximum absorption occurred, could not be observed clearly in beryl. The apparent activation energies for the relaxation were slightly larger than the value found in the original, unirradiated specimen, because the dielectric loss factor at frequencies lower than 0.5 kc is affected by irradiation. Based on structural considerations, a probable molecular mechanism responsible to these dielectric phenomena is presented. (BBB)

40023 IRRADIATION STUDIES OF CERAMIC-COATED NUCLEAR FUEL PARTICLES. Charles W. Townley, Neil E. Miller, Robert L. Ritzman, and Richard J. Burian (Battelle Memorial Inst., Columbus, Ohio). Nucl. Sci. Eng., 20: 171-9(Oct. 1964).

Irradiation studies of Al_2O_3-, BeO-, and pyrolytic-carbon-coated fuel particles were carried out. Alumina-coated UO_2 particles were found to be capable of a high

degree of fission-gas retention during irradiations to at least 10 per cent burnup at temperatures up to 1100°C. The use of thick Al_2O_3 coatings (about 60 microns) and porous UO_2 particles (about 80 per cent dense) was determined to be necessary to prevent cracking of the coatings at low temperatures. Coarse-grained beryllia coatings on UO_2 particles cracked during irradiations at 100°C and during thermal cycling in elevated temperature irradiations, but better performance is expected with fine-grained material. Failure of pyrolytic carbon coatings on UC_2 particles was prevented in low-temperature irradiations by using thick coatings (>100 microns), but at elevated temperatures it was learned that the coatings had to be multilayered as well. Very promising results were obtained for pyrolytic-carbon-coated UO_2 particles, good performance being observed over the temperature range of 100–1050°C. (auth)

40024 ELECTRONIC DESIGN FOR NUCLEAR SPACE VEHICLES. PART 2. A GENERALIZED APPROACH TO TRANSISTOR DAMAGE BY RADIATION. Frank Larin and Donald J. Niehaus (Bendix Corp., Southfield, Mich.). Nucleonics, 22: No. 9, 62-5(Sept. 1964).

A generalized method of test, analysis, and prediction–the on-factor technique is described, which simplifies analysis of radiation damage, separates bulk- from surface-damage effects, and permits extrapolation of test results over a wide range of operating conditions. (D.C.W.)

40025 ARGON DIFFUSION IN CALCIUM FLUORIDE AS A MODEL PROCESS FOR FISSION GAS TRANSPORT IN URANIUM DIOXIDE (RARE GAS DIFFUSION IN SOLIDS 15). T. Lagerwall (Hahn-Meitner-Institut fur Kernforschung, Berlin). Nukleonik, 6: 179-83(July 1964).

The mechanism of Ar diffusion in CaF_2 was determined. Between 600 and 1400°C lattice diffusion predominates with Ar atoms jumping from interstitial to interstitial, while transport below about 600°C proceeds along dislocations. The enthalpy of migration for the two processes is 67.4 and 8.1 kcal/mole, respectively; but in the high-temperature range the value is subject to changes due to variation of irradiation exposure. The effect of reactor irradiation on the diffusion was also studied. A moderate irradiation has the effect that measured diffusion coefficients are not representative for the real atomic process of diffusion. The apparent diffusion coefficient always lies below the real one; the discrepancy may finally exceed a factor of 1000 at high neutron doses. (auth)

40026 SENSITOMETRIC EFFECTS OF MILLION-VOLT X-RAYS ON SELECTED KODAK FILMS. B. K. Boller (Eastman Kodak Co., Rochester, N. Y.). Photo. Sci. Eng., 8: 185-8(July-Aug. 1964).

The effects of million-volt x-ray fogging exposures on the sensitometric characteristics of several Kodak aerial films and selected Kodak color films were determined. The data can be used for estimating the effects caused by exposure of films to hard gamma radiation. (auth)

40027 THE EFFECTS OF BACKGROUND RADIATION ON THE KEEPING QUALITY OF X-RAY FILMS. Donald P. Jones and Robert H. Barber (General Aniline and Film Corp., Binghamton, N. Y.). Photo. Sci. Eng., 8: 212-15 (July-Aug. 1964).

Modern high-speed x-ray films show some loss in speed and an increase in fog during prolonged storage under normal room conditions. The exact prediction of these changes in photographic properties by means of accelerated oven aging is difficult, and the conditions for such accelerated tests are hard to define for different film products. During the course of such an investigation, it was found that the fog growth of fast x-ray films during normal storage is almost entirely due to background radiation. Therefore, before the contribution of fog due to chemical influences alone can be predicted, the fog formation due to background radiation must be determined. The fog increase due to background radiation alone is related to the films' sensitivity towards the high-energy radiation of ^{60}Co. (auth)

40028 NEUTRON IRRADIATION OF TYPE 347 STAINLESS STEEL. Power Reactor Technol., 7: No. 2, 187-92 (Spring 1964).

The effects of fast neutron irradiation on the mechanical properties of type 347 stainless steel are summarized. Results are included on test samples cut from sections of the operating J-10 pressure loop of the Engineering Test Reactor. (N.W.R.)

40029 EFFECTS OF GAMMA RADIATION ON REVERSE-BIASED SILICON JUNCTIONS. D. R. Kerr (International Business Machines Corp., Poughkeepsie, N. Y.). Proc. IEEE (Inst. Elec. Electron. Engrs.), 51: 1142(Aug. 1963).

A degradation of reverse characteristics occurs at transistor collector junctions subjected to simultaneous reverse-bias and ionizing radiation. Increases of I_{CBO} by several orders of magnitude were observed in some device types, and the degradation was concluded to be a surface effect resulting from the accumulation of ions from the encapsulating gas on the surface near the reverse-biased junction. These would create an inversion layer with large leakage currents. Observation of this effect, to a lesser degree, is now reported in diffused silicon diodes and transistors with passivated surfaces. These units were planar-diffused structures with the passivation provided by a layer of thermally grown SiO_2 followed by a fused layer of lead borosilicate glass, each layer being about 1.3 μ thick. The devices were encapsulated in a silicone resin with an air-filled void over the junction region having a volume on the order of 10^{-5} cm^3. The transistor was a conventional NPN planar structure, and the diode was an N on P-substrate structure with a P diffusion surrounding the N electrode to give a boron surface concentration of 4×10^{20} cm^{-3}. With a reverse-bias of 20 v applied to the diodes and the transistor collector junctions, the units were exposed to γ radiation from a ^{60}Co source at a dose rate of 1.9×10^5 rad/hr. The reverse currents increased with the integrated radiation dose. The degradation varied considerably between the individual devices, but generally was limited to one order of magnitude at doses approaching 10^7 rad. Measurements for doses up to 10^8 rad show very little increase in leakage after this saturation is reached. Since the doping levels of diodes and transistors are similar, the apparent superior stability of the transistors is not understood. If the degradation is caused by movement of ionized contaminants within the passivation layers, the varied response of individual devices may be due to subtle differences in surface contamination during fabrication. Recovery of all units to their initial leakage values was observed after a one-hour exposure at 1.9×10^5 rad/hr without bias. Recovery at a rate several times slower was also noted for conditions of bias-no radiation and no bias-no radiation. It was shown that the surface effects of ionizing radiation on reverse-biased junctions may be greatly reduced by isolating the encapsulating gas from the device surface with a passivation layer. This study indicated that a double layer of oxide and glass may be superior to single

layers of oxide or varnish, but more data are needed to establish optimum structures. (BBB)

40030 EFFECTS ON ELASTOMERS OF GAMMA IRRADIATION AND HIGH VACUUM. Charles A. Cassola and Angelo F. Bonanni (Naval Engineering Center, Philadelphia). Rubber Age (N. Y.), 95: 414-19(June 1964).

The effects of gamma radiation elastomeric materials under a high vacuum were studied. The elastomers were tested after exposure to various dosages of gamma radiation (7.2×10^6, 1.44×10^7, 2.16×10^7, and 7.92×10^7 Rads) and various environments: open atmosphere, closed atmosphere (sealed ampule), and a vacuum of 5×10^{-5} Torrs (sealed ampule). The effects of these conditions on the tensile strength, percent elongation, percent weight change, and actual weight change are reported. A unique method was devised to encapsulate the test specimens in a vacuum using an electron beam welder. The application of such an instrument for this purpose provided a rapid method in the preparation of specimens in a vacuum for exposure to radiation. (P.C.H.)

40031 PROPAGATION OF DISLOCATIONS IN IRRADIATED CRYSTALS. I. G. Berzina and I. B. Berman (Tomsk Polytechnic Inst., USSR). Soviet Phys.-Cryst. (English Transl.), 9: 202-5(Sept.-Oct. 1964). Translated from Kristallografiya, 9: 260-4(Mar.-Apr. 1964).

Microhardness and dislocation distribution around an indentation on etched (100) faces of irradiated LiF, NaCl, and KCl crystals were studied. A relationship was obtained between the length of the rays of the etch figure star in the above-mentioned crystals and the proton irradiation dose. (auth)

40032 EFFECTS OF X RAYS ON THE STRUCTURE OF PENTAERYTHRITOL. E. V. Kolontsova and I. V. Telegina (Moscow State Univ.). Soviet Phys.-Cryst. (English Transl.), 9: 221-3(Sept.-Oct. 1964). Translated from Kristallografiya, 9: 282-4(Mar.-Apr. 1964).

The effects of x radiation on the structure of pentaerythritol were investigated. Differences from the control crystals became apparent after 40–50 hr; the irradiated crystals showed stronger diffuse peaks and broader Laue spots. These changes increased with the irradiation time. Pronounced asterism appeared after 80–100 hr, which indicated that the crystal breaks up into blocks differing slightly in orientation. The crystals were unaffected by even 1000 hr under the same conditions provided that they were shielded. Irradiation also caused pentaerythritol to become opaque; the appearance became that of mother of pearl after 30–40 hr. The cleavage improved as irradiation proceeded, and eventually this resulted in complete parting of the crystals on (001) planes. (P.C.H.)

40033 THE APPLICATION OF IRRADIATED POLYETHYLENE FILM TO PACKAGING. J. Morioka. Sumitomo Denki, No. 83, 108-16(Dec. 1963). (In Japanese)

Studies on irradiated polyethylene, "Irrax," which has good properties such as high heat resistance, easy heat sealing, good transparency, printability, and nontoxicity showed it to be satisfactory for commercial packaging instead of canning of foods. The properties of various types of packaging films; e.g., specific gravity, deformation temperature, the possibility of vacuum packaging, oxygen and vapor permeabilities, tensile strength, elongation, acid and alkali resistivities, and price range, are tabulated. A comparison of the irradiated films (Irrax, polyethylene + polypropylene, and polyethylene + polyethylene terephthalate) showed that Irrax was the most suitable because Irrax can be used in heat sterilization at temperatures over 100°C, at temperatures <– 60°C, and to preserve almost all foods for several months at room temperature. (OID)

40034 EFFECTS OF DEGREE OF GRAPHITIZATION ON THE IRRADIATION BEHAVIOR OF ARTIFICIAL GRAPHITE. E. Fitzer and W. Fritz (Technische Hochschule, Karlsruhe, Ger.). Z. Metallk., 55: 473-84(Aug. 1964.) (In German)

The behavior of polycrystalline graphite during irradiation is discussed with regard to the type of graphite and the necessity of classifying these types according to the anisotropy ratio, the packing density (the portion, shape, and size of pores, and the degree of graphitization.) The degree of graphitization as a measure of the mean crystalline order in polycrystalline graphites seemed to be a good characteristic value for the expected irradiation damage. For high-temperature shrinkage this value seemed to be of similar significance. (auth)

40035 RADIATION EFFECTS ON TOUGHNESS OF FERRITIC STEELS FOR REACTOR VESSELS. An AEC Monograph. L. P. Trudeau (International Nickel Co. of Canada Ltd., Toronto). Monograph Series on Metallurgy in Nuclear Technology. New York, Rowman and Littlefield, Inc., 1964. 187p. $9.65 (Rowman and Littlefield, Inc.).

A monograph is presented to show how irradiation affects the toughness of ferritic steels and to show the associated implications. Descriptions of criteria used to evaluate toughness of reactor steels are described, and suggestions concerning minimization of embrittlement are included. (J.R.D.)

40036 RADIATION DAMAGE TO SOLAR CELLS ON RELAY I AND RELAY II. Ramond C. Waddel (Goddard Space Flight Center, Greenbelt, Md.). 17p. (CONF-657-1)

From 4th Annual Photovoltaic Specialists Conference, Cleveland, June 1964.

The results of solar cell radiation damage experiments on board Relay I and Relay II, both of which are still active, are reported, and the degree of agreement between predictions of radiation damage, based on laboratory damage studies and flux data, and that observed in the spacecraft experiments are indicated. The results from both experiments, where comparable, were found to be similar. Unshielded Si (1 ohm-cm) and GaAs solar cells degraded to the 75% initial short circuit current response level in less than one day. The order is Si P/N, GaAs, and Si N/P. Heavily shielded N/P Si cells lasted about 10 times as along as similarly shielded P/N cells. Silicon N/P cells with 60 mil silica shields lasted about 2.4 times as long as similar cells with 30 mil shields. Tentative results from Relay II indicate that GaAs cells with 3 and 12 mil glass shields were about as damage resistant as the Si N/P cells with 60 mil silica shields, judged at the 90% response level. Gallium arsenide cells with 30 and 60 mil silica shields appeared considerably more damage resistant than Si N/P cells with 60 mil shields. (P.C.H.)

40037 RADIATION DAMAGE TO CdS SOLAR CELLS. Henry W. Brandhorst, Jr. and Russell E. Hart (Lewis Research Center, Cleveland). 13p. (CONF-657-2)

From 4th Annual Photovoltaic Specialists Conference, Cleveland, June 1964.

Radiation effects of electrons at 2.5, 1.0, and 0.6 Mev on CdS solar cells were studied. Several measurements, such as short-circuit current, maximum power, and open-circuit voltages, were made on each cell. Mylar and H film cells

reached 10^{17} electrons per cm^2 with no degradation of electrical characteristics. Tedlar cells failed rapidly. The degradation of short-circuited current of CdS cells exposed to protons was very slight. However, somewhat more degradation was observed in the variation of the maximum power of the cells with proton dose. It was concluded that the radiation resistance of CdS thin-film solar cells is not a major problem. (P.C.H.)

METEOROLOGY

40038 (AAEC/TM-243) VALUES OF SUTTON'S TURBULENCE INDEX AS CALCULATED FROM WIND PROFILES AT LUCAS HEIGHTS. E. Charash (Australia. Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales). May 1964. 13p.

Statistical summaries are presented of values of Sutton's turbulence index n, calculated from vertical wind profiles at Lucas Heights. It was found that a great scatter of n-values is associated with any temperature gradient, and that stability alone cannot serve as a basis for determining the n-parameter. This is interpreted as the effect of terrain at Lucas Heights, and some evidence is adduced which indicates that momentum transfer is controlled more by mechanical turbulence created by rugged contours than by buoyancy forces. It is shown however that the scatter in n-values is dependent in no small measure upon the height and depth of the layer through which the wind profile is measured, and can be significantly reduced by a judicious selection of these levels. (auth)

40039 (AAEC/TM-244) EFFECTS OF TOPOGRAPHY ON SURFACE WINDS AT LUCAS HEIGHTS. E. Charash (Australia. Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales). Apr. 1964. 9p.

An analysis of observed surface winds and geostrophic winds at Lucas Heights shows that in 40% of all cases the air flow from a southerly and southeasterly direction is deflected in a manner which may be explained as an effect of topography. (auth)

40040 (CONF-337-41) COMPUTATION OF ATMOSPHERIC DISPERSION PARAMETERS AT REACTOR SITES BY A SMOKE PLUME RATIO METHOD. F. A. Gifford, Jr., Walter M. Culkowski, and William F. Hilsmeier (Weather Bureau, Oak Ridge, Tenn.). Apr. 1963. 13p.

From International Conference on Radioactive Pollution of Gaseous Media, Saclay, France, Nov. 1963.

Formulas previously obtained, for the determination of Sutton diffusion parameters from simple measurements of smoke plume length-width ratios, are summarized. Using these, diffusion parameters at or near four U. S. nuclear reactor installations were determined; in each instance, the requisite plume length-width ratio information was obtained from published photographs. For several of the resulting estimates of diffusion parameters, an independent estimate based on actual measured air concentration measurements is available. The "observed" diffusion parameter values (i.e., those inferred from air concentration measurements) and the values predicted by the present method are in reasonable agreement, although the ratio method values are somewhat larger. The ratio method is distinguished by its simplicity and extreme economy. On the theoretical side, it is based on exactly the same diffusion models that are ordinarily employed in more elaborate reactor site diffusion studies. The suggestion is that it should prove to be a useful, practical method by which to determine diffusion parameters at reactor sites, particularly sites, where either a large, permanent meteorological office is not contemplated, or where the expense of more elaborate atmospheric sampling studies of diffusion does not seem to be warranted. (auth)

40041 (CONF-337-42) METEOROLOGICAL INFLUENCES UPON Sr^{90} DEPOSITION RATES BY PRECIPITATION. Paul Kruger (Stanford Univ., Calif. and Hazleton-Nuclear Science Corp., Palo Alto, Calif.). [1963]. Contract AT(04-3)-457. 35p.

From International Conference on Radioactive Pollution of Gaseous Media, Saclay, France, Nov. 1963.

Meteorological analysis of several types of precipitation-producing storm systems has been combined with radiochemical analysis for fission nuclear debris deposition through precipitation. Temporal and spatial distributions of fallout concentrations have been examined for: (1) large-scale uplift systems in central Pennsylvania; (2) convective shower activity in central Pennsylvania and, more recently, Oklahoma; (3) Pacific Ocean cyclonic storm systems in California and along the West Coast, and (4) orographic precipitation along the slopes of Mauna Loa volcano in Hawaii. The results show the strong dependence of nuclear debris deposition upon synoptic parameters, with deposition rates changing slowly during precipitation in stable air, and as much as factors of over 100 in short-time periods during intense convective conditions. For large-scale uplift, ^{90}Sr concentrations are shown to be dependent upon descent experience below the clouds when precipitation is falling from relatively constant generating levels. For convective activity, ^{90}Sr concentrations are shown to be dependent upon the maximum height and intensity of convective cells and their location with respect to the tropopause, the jet stream, and regions of high dry air concentrations of nuclear debris of recent stratospheric origin. For Pacific cyclones, ^{90}Sr concentrations are shown to be dependent upon air mass trajectories, the intensity of the marine layer inversion, and concurrent large-scale and convective activities. Work is in progress on initial studies of orographic precipitation. (auth)

40042 (HW-SA-3685) LESS-FAMILIAR FACTORS IMPORTANT IN AIR POLLUTION EVALUATIONS. J. J. Fuquay (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). [196?]. Contract AT(45-1)-1350. 14p. (CONF-652-2)

From American Industrial Hygiene Association Pacific Northwest Section Meeting, Richland, Wash., Aug. 1964.

It was shown that there are several factors important in evaluation of industrial air pollution problems which are not generally considered, although mention of them has been made in the literature for several years. Specification of air quality criteria compatible with the manner in which pollution is dispersed by the atmosphere and the nature of use of surrounding land was shown to significantly add to the value of air pollution evaluations. Dilution in the stack was treated on a basis compatible with the rate of release concept basic to atmospheric dispersion calculations. It was shown that specification of maximum concentration permissible in the environs requires also an appraisal of the probability of exceeding this maximum and the probability of overexposure based on numbers of persons potentially exposed. Utilization of these concepts in evaluation of multiple source problems in an industrial complex was discussed. (auth)

40043 RESULTS OF RECENT FIELD PROGRAMS IN ATMOSPHERIC DIFFUSION. James J. Fuquay (General Electric Co., Richland, Wash.), Charles L. Simpson, Morton

L. Barad, and John H. Taylor. J. Appl. Meteorol., 2: 122-8(Feb. 1963).

During the summer of 1959, the Green Glow program, consisting of 26 diffusion experiments during nocturnal inversions, was conducted at the Atomic Energy Commission's Hanford Site near Richland, Wash. The tracer, zinc sulfide, was released near ground level. Samplers were placed at 1.5 m above ground at 533 positions on six sampling arcs, the radii of which were 200 and 800 m and 1.6, 3.2, 12.8, and 25.6 km. In addition to the ground sampling network, poles or towers were erected at 5 points, 8° apart, on each of the 4 inner arcs. Fifteen samplers were mounted on each pole or tower, the top level increasing from 27 m on the 200-m arc to 62 m on the 1.6 and 3.2-km arcs. General aspects of the experimental design and tracer technique are discussed along with terrain characteristics and meteorological conditions pertinent to these experiments. Experimental results are presented showing the increase in horizontal plume width and decrease of maximum exposure with distance from the source. An analysis of the area enclosed within a given exposure isopleth is summarized. The effect of significant wind direction shear on the vertical distributions of exposure is discussed. Results from the Green Glow experiments are compared with those from earlier diffusion experiments at O'Neill, Nebr., and later experiments at Hanford. (auth)

PHYSICS

General

Refer also to abstract 39444.

40044 (BMI-1688) EXPERIMENTAL AND THEORETICAL STUDIES OF FISSION-PRODUCT DEPOSITION IN FLOWING HELIUM. Gilbert E. Raines, Arnold Abriss, David L. Morrison, and Robert A. Ewing (Battelle Memorial Inst., Columbus, Ohio). Aug. 21, 1964. Contract W-7405-eng-92. 40p.

Deposition of fission products from helium gas streams at high temperatures and flowing at high velocities was experimentally measured in an out-of-pile loop of stainless steel. Gamma-emitting fission products evolved from mildly irradiated UC_2 fuel elements and deposited in significant quantities included ^{131}I, ^{132}Te, ^{129}Te, ^{137}Cs, $Zr-^{96}Nb$, $Ba-^{140}La$, ^{141}Ce, and ^{103}Ru. Deposited fission products were determined by a least-squares computer analysis procedure developed to analyze the gamma spectra obtained on small sections of the loop. Theoretical correlation of the experimental data showed that deposition in isothermal regions can be represented reasonably well by finite-difference solutions of the diffusion equation allowing for flow and a linearized adsorption reaction at the wall. Deposition of iodine did not conform to the generalized theories applicable to other fission products. (auth)

40045 (BNL-7350) A TREATMENT OF THE METALLIC IMPURITY PROBLEM USING GREEN'S FUNCTIONS. D. A. Goodings and Bernard Mozer (Brookhaven National Lab., Upton, N. Y.). [1963]. Contract [AT(30-2)-Gen-16]. 9p.

The weighted density of electronic states (or the charge or spin density) associated with an impurity in a metal is easily derived in terms of a Green's function for the pure metal. The Green's function for either the pure metal or metal with an impurity has a particularly simple form when expressed in the Wannier function representation. The weighted density of electronic states associated with the impurity is simply related to a generalized Green's function for the impurity as shown by Waller for the analogous problem in lattice dynamics. The weighted density of electronic states so derived is useful in interpreting results on the study of impurity effects such as the isomeric shift and quadrupole splitting observed in the Mössbauer effect on impurities in metals. For a single conduction band and localized impurity interaction potential one easily obtains the results of Clogston for the Knight shift at an impurity. Wolff's "self consistent equations" are also readily obtained using a simple spin dependence in the matrix element of the interaction potential. (auth)

40046 (BNL-7666) THE ROLE OF POINT DEFECTS IN SOLID STATE REACTIONS. G. J. Dienes (Brookhaven National Lab., Upton, N. Y.), A. C. Damask (Brookhaven National Lab., Upton, N. Y. and Frankford Arsenal. Pitman-Dunn Lab., Philadelphia). [1963]. Contract AT-30-2-GEN-16. 21p. (CONF-489-2)

From 5th International Symposium on the Reactivity of Solids, Munich, Aug. 1964.

Lattice vacancies play a crucial role in solid-state reactions because diffusion processes in a large class of solids are controlled by the concentration and mobility of vacancies. They take part in a variety of processes leading to phase changes, precipitation, order-disorder transformation and chemical reactions in solids. The kinetics of the migration of vacancies, their interactions with each other and with impurity atoms, can be described in terms of chemical rate theory. In metals there is often a positive binding energy between vacancies and impurity atoms. A derivation for vacancy-impurity complex concentration is given and estimates of binding energies are discussed. The effect of the binding of excess vacancies to impurity atoms on the kinetics of migration is investigated. It is shown that if a highly mobile impurity-vacancy complex is formed, then excess vacancies accelerate the segregation of impurities. Conversely, if the impurity-vacancy complex is relatively immobile, then the impurities retard the disappearance of the vacancies. Several important parameters such as the impurity-vacancy binding energy and the rate and amount of impurity segregation, can be derived from annealing experiments by the application of a simple kinetic theory, which is based on the verification of analytic approximations by computer techniques. (auth)

40047 (LA-DC-6463) LOCALIZED MOMENTS OF VERY DILUTE Fe IMPURITIES IN METALS FROM MÖSSBAUER EFFECT STUDIES OVER THE RANGE 9.5 TO 300°K. R. D. Taylor, T. A. Kitchens, and W. A. Steyert (Los Alamos Scientific Lab., N. Mex.). [1964]. Contract W-7405-eng-36. 9p. (CONF-651-1)

From 9th International Conference on Low Temperature Physics, Columbus, Ohio, Aug.-Sept. 1964.

A method of studying the hyperfine spectra at Fe impurity nuclei in metals as a function of applied magnetic field and of temperature is discussed by which the presence of a localized magnetic state about dilute Fe impurities can be demonstrated in a number of host elements. (J.R.D.)

40048 (NASA-TN-D-2470) EXPERIMENTAL EVALUATION OF SIZE EFFECTS ON STEADY-STATE CONTROL PROPERTIES OF ELECTRON-BOMBARDMENT ION THRUSTOR. Eugene V. Pawlik and Shigeo Nakanishi (National Aeronautics and Space Administration. Lewis Research Center, Cleveland). Sept. 1964. 25p.

The steady-state gains (variation of beam current with changes in thrustor input variables) were determined experimentally for electron-bombardment ion thrustors 5 to 20 cm in diameter. Thrustor operation with an alkali earth coated filament was also investigated. Size effects on the control properties or gains of the ion thrustor were small except for propellant flow effects in the smallest unit. Mercury was used as the propellant, and the tests were conducted primarily at a specific impulse of 4000 sec. (auth)

40049 (NP-14232) SLOW VISCOUS MHD FLOWS ABOUT MAGNETIZED SPHERICAL BODIES. Vivian O'Brien (Johns Hopkins Univ., Silver Spring, Md. Applied Physics Lab.). June 1964. 27p. (CM-1047)

Axisymmetric aligned MHD viscous flows about magnetized bodies are discussed in terms of Stokes stream-function ψ and a corresponding magnetic flux function Ψ. The first-order MHD fields of a number of magnetized spheres were calculated. Some cases are previously published results re-evaluated by this more convenient

method. The analysis can be extended to other bodies and other magnetic configurations. (auth)

40050 (RM64TMP-17) AXIAL-SYMMETRIC BLAST WAVES IN FLUID DYNAMICS AND MOTION OF PARTICLES. G. M. Schindler (General Electric Co. Technical Military Planning Operation, Santa Barbara, Calif.). Apr. 15, 1964. 107p. (DASA-1507; AD-605201)

Given is a solution of axial-symmetric shock waves in fluid dynamics generated by a point source explosion and with the determination of the particle paths. The entire blast wave problem is formulated as a classical initial-boundary value problem; some approaches to its numerical solution are elaborated. Special attention is paid to the uniqueness of the solutions and to the possibility of determining geometric configuration and expansion rate of the shock wave without integrating the fluid dynamics equations. The effectiveness of the method developed is demonstrated in an application to a particular situation. (auth)

40051 (RM63TMP-25) ENTRAINMENT AND EXPANSION-CONTROLLED FIREBALL RISE. Gerhard Rohringer (General Electric Co. Technical Military Planning Operations, Santa Barbara, Calif.). July 1, 1963. Contract DA 49-146-XZ-038. 62p. (DASA-1409; AD-436085)

A detailed analysis was made of the buoyant rise of fireballs in the earth's atmosphere. Formulas for the rise velocity and height, and the density, mass, radius, and expansion velocity of the fireball are given. The computation of fireball temperature is discussed in detail; no explicit expression could be given because of the nature of the problem. The assumptions and simplifications on which the analysis rests are summarized. In order to facilitate applications, a complete numerical example is given. Frequently used quantities are calculated and presented in graphical and tabular form. (auth)

40052 (TID-21037) THE ABSORPTION OF SOUND IN METHANE-d (thesis). Willie Austin Davis (Vanderbilt Univ., Nashville. Graduate School). May 1964. 42p.

The absorption of sound was measured in methane-d at 26°C by use of the sound tube method. A fixed microphone and movable speaker, both enclosed in a cylindrical glass tube, were used. The microphone output level was plotted versus speaker-to-microphone distance, and the total absorption was obtained from the slope of the resulting line. Classical and tube absorption were calculated and subtracted from total absorption to yield relaxation absorption. A plot of relaxation absorption versus the logarithm of frequency over pressure provided a bell-shaped curve from which the experimental maximum relaxation absorption and the frequency at which it occurred were obtained. The experimental value for maximum relaxation absorption, 0.0940 nepers per wavelength, agrees closely with the theoretical value, 0.0947 nepers per wavelength. The frequency at which maximum absorption occurred was 115 kilocycles per atmosphere, corresponding to a relaxation time of 1.60 microseconds. Values of transition probability and collision efficiency were obtained. The relaxation time of the directly activated mode corresponding to the lowest energy level was calculated to be 0.479 microseconds. The transition probability was 2.09×10^6 sec^{-1}, and the collision efficiency was determined to be 1.86×10^{-6}. The average number of collisions per energy transfer was calculated to be 5,400. The investigations of the effect of deuteration of methane on intermolecular energy transfer indicate that maximum relaxation absorption increases with an increase in deuteration. Except for CH_2D_2, collision efficiency decreases with increase in deuteration. (auth)

40053 (UCRL-7572-T) DEPENDENCE OF LATTICE GAS PROPERTIES ON MESH SIZE. W. G. Hoover, B. J. Alder, and F. H. Ree (California. Univ., Livermore. Lawrence Radiation Lab.). Nov. 1963. Contract [W-7405-eng-48]. 21p.

The way in which the properties of a lattice gas converge, as the number of sites covered per particle is increased, to the properties of a real gas, in which the configuration space is a continuum, is investigated. For one-dimensional hard lines the real gas and lattice gas properties can be exactly worked out and compared for any mesh size. It is shown that for any density the free volume per particle must be at least 50 lattice sites for the lattice gas pressure to approximate the real gas pressure within 1%. If the limit of close-packing the lattice gas leads to an incorrect asymptotic form of the pressure for any finite mesh size. For squares in two dimensions and cubes in three dimensions it appears that the asymptotic high density behavior is of the same form as in one dimension. Inequalities between the real gas configurational integral and the lattice gas configurational sum are equally valid in one, two, three, ... dimensions. It is shown that in one, two, and three dimensions the virial coefficients for a lattice gas with a coarse spacing differ in order of magnitude from the real gas coefficients. A simple way of interpreting lattice gas results in terms of the corresponding real gases is described and applied to two- and three-dimensional gases. (auth)

40054 (ORNL-tr-221) APPLICATIONS OF THE MÖSSBAUER EFFECT. B. N. Petrov, S. N. Bernov, and D. Ya. Libenson. Translated by Martha Gerrard and John J. Pinajian (Oak Ridge National Lab., Tenn.), from Vestn. Akad. Nauk SSSR, 33: 40-3(July 1963). 7p.

A review of Mössbauer effect uses is presented. Types of interactions are noted that make it possible to obtain information on the ground and excited states of nuclei, particularly on the medium surrounding the nucleus, which is often impossible by any other method. It is noted that applications of the Mössbauer effect open wide areas for studies of solid bodies in chemistry and that a great many applications need further study. (J.R.D.)

40055 EFFECTS OF CHARGED PARTICLES ON THE MOTION OF AN EARTH SATELLITE. Clark L. Brundin (Univ. of California, Berkeley). AIAA (Am. Inst. Aeron. Astronaut.) J., 1: 2529-38(Nov. 1963).

The forces acting on a satellite, which influence prediction of its decay time, arising through the interaction of the satellite with the charged and neutral particles in the atmosphere, are discussed. While the effects of neutral particles are understood, contradictory predictions have been made on the drag due to charged particles; therefore, a thorough review and analysis of the published work on this problem are presented, and equations are developed whereby the upper limits of the drag due to charged particles can be estimated. The causes of the contradictions in predicted charged particle drag are explained, and an overall description of the phenomena involved is given. On the basis of the model of the upper atmosphere that is presented, in which the principal atmospheric constituent (for both atoms and ions) changes with increasing altitude from atomic O to He and then to atomic H, the charge on a conducting spherical satellite and the drag due to charged particles are estimated for altitudes below the H region. The effects of photoelectric emission and the earth's magnetic field are included in the calculations. It is found that the contribution of charged particles to the satellite drag may be neglected in the O region. In the He region the drag

due to charged particles may be significant, particularly for large satellites and in cases where the photoelectric emission current is significant. A method of estimating this drag is presented, the results of which are applicable to satellites large with respect to the Debye length. Apart from the possible effects of plasma waves or plasma oscillations, in the calculation of the drag on such a satellite, the fact that some atmospheric particles are charged can be neglected below the altitude at which H becomes the principal atmospheric constituent. These methods of calculation are not applicable to the region where H is the principal atmospheric constituent. (BBB)

40056 GENERAL SOLUTIONS OF THE HAMILTON-JACOBI EQUATION. Saul T. Epstein (Univ. of Wisconsin, Madison). Am. J. Phys., 32: 688-90(Sept. 1964).

The importance of finding general solutions to the Hamilton-Jacobi equation is emphasized. The procedure for doing so is presented, with examples of its use. (auth)

40057 ON THE RELATIVISTIC DYNAMICS OF THE SYSTEMS OF PARTICLES. Alexandru Timotin. Bul. Inst. Politeh. Bucuresti, 25: 105-12(Nov.-Dec. 1963). (In Romanian)

The law of the relativistic variation of mass with velocity and the law of conservation of momentum for a system of particles are deduced (by using the principle of relativity) from the conservation of mass, as a characteristic property of the mechanical interactions (collisions). (auth)

40058 MEASUREMENT OF GAS VELOCITY BEHIND A SHOCK WAVE. G. D. Salamandra, I. K. Fedoseeva, and N. M. Bykova. Inzh. Fiz. Zh., Akad. Nauk Belorussk. SSR, 7: 96-9(May 1964). (In Russian)

A method of measuring subsonic gas velocity behind a shock wave is presented. Gas velocity is measured by two independent methods: by motion of a set of heat irregularities created by a spark discharge in a moving medium behind a shock wave, and by shock wave propagation accompanying a spark discharge in gas flow behind the wave. The results of both methods are in a good agreement. (auth)

40059 KINETIC THEORY OF A WEAKLY COUPLED GAS. C. G. Su (Massachusetts Inst. of Tech., Cambridge). J. Math. Phys. (N. Y.), 5: 1273-90(Sept. 1964).

Using the multiple-time-scale method on the BBGKY hierarchy, the weak coupling expansion is carried out to higher orders. It is found that there are two local breakdowns of the expansion. One occurs at small relative velocities between particles. The correct asymptotic representation for the small relative velocity region is given. The second breakdown occurs for particles having a large separation at t with their relative velocity oriented in such a way that they were in collision at $t = 0$. Such a breakdown indicates that in contrast to the Bogoliubov functional assumption, the higher-order correlation functions should vary on the kinetic time scale in their own right. A sufficient condition on the smoothness of the initial correlation functions is given such that one obtains the Fokker-Planck equation at the lowest-order approximation in the expansion. The connection between irreversibility and the requirement of nonsecularity in the multiple-time-scale formulation is also indicated. (auth)

40060 THE UNIQUENESS OF WEAK SOLUTIONS OF THE ONE-DIMENSIONAL SCALAR ANALOG TO THE NAVIER-STOKES EQUATION. Edgar A. Kraut (Univ. of California, Los Angeles). J. Math. Phys. (N. Y.), 5: 1290-2(Sept. 1964).

A uniqueness theorem for solutions of the one-dimensional scalar analog to the Navier-Stokes equation is stated and rigorously established. (auth)

40061 SOME BASIC PROPERTIES OF THICK ELECTROSTATIC LENSES. Gyula Paris. Magy. Tud. Akad. Kozp. Fiz. Kut. Int. Kozlemen., 12: 185-99(1964). (In Hungarian)

The rigorous solution for the potential distribution $v = \gamma + th\omega z$ is given for the equation of paraxial motion in the case $\gamma = 1$. An immersion lens similar to the Glaser type unipotential single lens was analyzed using Lamé and Hill type differential equations. If the lens has a focal plane, the paraxial equation can be always transformed to a Hill type equation. Another immersion lens investigated gave a good approximation to the accelerator tube with homogeneous field produced by the combination of quadratic and linear potential distributions. Considered in terms of voltage multiplication either lens may be focusing or defocusing. (auth)

40062 PROPAGATION OF A GASEOUS DISCHARGE IN A CROSSED MAGNETIC FIELD. A. E. D. Heylen (Univ. of Leeds, Eng.). Nature, 203: 745(Aug. 15, 1964).

The work of Townsend on the application of a crossed magnetic field to an electron swarm moving under the influence of a uniform electric field to derive the high electron drift velocities is extended to include the numerous practical cases in which Townsend's secondary ionization coefficient comes into play in the full development of a gaseous discharge. (C.E.S.)

40063 RADIOGRAPHIC EFFECTS DUE TO THE WAVEFORMS OF X-RAY TUBE VOLTAGES AND CURRENTS. PART 2. EFFECTS OF TRANSMITTED X-RAYS THROUGH OBJECTS AND ON FLUORESCENCE-BRIGHTNESS OF AN INTENSIFYING SCREEN. Hitoshi Kanamori (Shimadzu Seisakusho Ltd., Kyoto). Nippon Igaku Hoshasen Gakkai Zasshi, 23: 565-73(Aug. 25, 1963). (In Japanese)

Uniform radiographs result not only from constant kvp and ma-sec values in x-ray radiography, but variation of waveforms of tube voltages and currents are also responsible for nonuniformity. Effects due to the three kinds of waveforms (single-phase, three-phase, and constant) were studied experimentally. Transmitted dose-rates were measured by dosimeters, and brightness of fluorescence generated by means of the integration of photocurrent in a photomultiplier. The results showed that a constant waveform generates harder quality and larger quantity of radiation than a single-phase waveform does, when the same kvp is used. This is well known but has not been evaluated accurately before. The difference in hardness decreases as kvp increases and becomes almost equal when kvp exceeds 80. The difference in quantity of radiation also decreases as kvp values increase. These characteristics may be caused by the soft radiation absorption of various objects, and the radiation produced by a single-phase waveform may undergo a greater degree of soft radiation absorption than that of constant waveform radiation. This difference is markedly evident when kvp decreases. Transmitted radiation is hardened as thickness increases. This appears more pronounced in aluminum than acrylite. Acrylite has flatter absorption coefficient characteristics with respect to photon energy than aluminum, so that soft radiation is absorbed more rapidly by aluminum than by acrylite. It was found that the efficiency of fluorescence generation depends only on HVL (half-value layer) or effective kv of radiation. The above experimental results could be reduced theoretically to an equation if the spectral distribution of radiation intensity and that of absorption coefficients are known. However, spectral

intensity distribution is not exactly known when 30 to 150 kv is used as in the case of diagnostic studies. Therefore, Kulenkampff's equation, which is applicable to 7- to 12-kv radiation produced by constant waveform, was applied provisionally. Calculated distributions for the three waveforms are shown. The area under the spectral intensity curve shows the relative dose rate. When the areas under the curves were compared with air dose rates, the experimentally obtained characteristics agreed roughly with the calculated results. However, the experimental results gave a harder quality of x rays than the calculations. This suggests that the second term of Kulenkampff's equation, which expresses the self-hardening effect of the anode, should be estimated to be greater for higher tube voltages. (BBB)

40064 RADIAL DISTRIBUTION FUNCTIONS FOR THE GAUSSIAN MODEL. David D. Carley (Univ. of Florida, Gainesville). Phys. Rev., 136: A127-32(Oct. 5, 1964).

Radial distribution functions g are computed for the Gaussian model using the Monte Carlo (MC) method and the convolution-hypernetted-chain (CHNC) and Percus-Yevick (PY) integral equations. These results are compared with the density-expansion results obtained by Helfand and Kornegay (HK). For low density, the MC, PY, and CHNC g's show excellent agreement with HK data, indicating that the errors introduced in the numerical solutions are small. At higher densities the HK data are no longer applicable, but the PY, CHNC, and MC results continue to show good agreement, with closest agreement between CHNC and MC results. (auth)

40065 DRIFT VELOCITIES OF ELECTRONS IN CESIUM. Lorne M. Chanin and R. D. Steen (Honeywell Research Center, Hopkins, Minn.). Phys. Rev., 136: A138-41(Oct. 5, 1964).

The drift velocities of electrons in cesium vapor were measured for E/p_0 values between 0.8 and 20 v/cm × torr at temperatures between 566 and 725°K. The data were obtained from electron transit-time measurements using a pulsed-discharge technique. By obtaining differential transit times, injection and end-effect errors were minimized. The general variation of the drift velocity with E/p_0 was found to be comparable to that previously observed for some of the noble gases. (auth)

40066 GENERAL RELATIVISTIC INSTABILITY. J. P. Wright (Univ. of Wisconsin, Madison). Phys. Rev., 136: B288-9(Oct. 12, 1964).

The point of instability of a general relativistic fluid sphere is determined using the criterion that the point of instability occurs when the binding energy is at a maximum. The result is equivalent to the result obtained by the small-perturbation method when the radius is sufficiently large. (auth)

40067 ON THE EXISTENCE OF MAGNETIC MONOPOLES. R. A. Ferrell and J. J. Hopfield (Univ. of California, Berkeley). Physics, 1: 1-2(July-Aug. 1964).

By the Bohm-Aharonov effect, the flux within a long slender solenoid is observable unless it is a multiple of hc/e. In this case only the ends of the solenoid produce any physical effect and they behave as magnetic monopoles with strength quantized according to Dirac. (auth)

40068 THE STABILITY OF HYDROMAGNETIC COUETTE FLOW. P. H. Roberts (Yerkes Observatory, Williams Bay, Wis.). Proc. Cambridge Phil. Soc., 60: 635-51(July 1964).

The theoretical studies of Chandrasekhar on the stability of Couette flow in a viscous, electrically conducting, fluid in the presence of a uniform axial magnetic field are extended to include cases of finite gap width between the cylinders, and cases in which the conductivity of the walls of the containing cylinders is finite. In addition, the non-axisymmetric modes of instability are discussed, and the results of numerical computations are presented. (auth)

40069 RAREFIED GAS DYNAMICS. VOLUME I. Proceedings of the Third International Symposium Held at Paris, 1962. J. A. Laurmann, ed. Advances in Applied Mechanics, Suppl. 2. Proc. Intern. Symp. Rarefied Gas Dyn., 3rd, Paris, 1962, 1: 1-541(1963). New York, Academic Press, 1963. $16.00.

Fundamental kinetic theory, solutions of the Boltzmann equation, molecular beams, and surface interactions are discussed. Separate abstracts are prepared for 22 of the 28 papers presented. Two papers previously appeared in NSA (17: 34650 and 39456). (C.E.S.)

For abstracts of individual papers see: 39444, 39445, 40070, 40071, 40072, 40073, 40074, 40075, 40149, 40150, 40151, 40152, 40153, 40154, 40155, 40156, 40157, 40158, 40159, 40160, 40702, and 40705.

40070 ON THE CONVERGENCE AND ERROR ESTIMATION OF THE ITERATIVE SOLUTION TO THE NONLINEAR BOLTZMANN EQUATION. W. A. Janos (Raytheon Co., Wayland, Mass.). Proc. Intern. Symp. Rarefied Gas Dyn., 3rd, Paris, 1962, 1: 60-74(1963).

The method of solution of the Boltzmann equation investigated is that of successive linearization of the collision integral. A sequence of linear approximations is generated, starting from some known solution which is assumed close to the true one. The linearization is the conventional one where, say, the (n−1)st approximation is solved in the collision kernel for the nth approximation. The case for n = 0 is the starting point, the collisionless known solution, which may correspond to an initial distribution given at time zero, or, for steady state, the free molecular collisionless distribution given at some point far from a collision affected region. Criteria, in the form of inequalities involving physical parameters, are established for the convergence and error bounds of this sequence of approximations. (auth)

40071 A CRITERION FOR THE DEGREE OF DEPARTURE FROM EQUILIBRIUM AND ITS APPLICATION TO RAREFIED GASES. Michal Lunc (Univ. of Warsaw and Inst. for Nuclear Research, Warsaw). Proc. Intern. Symp. Rarefied Gas Dyn., 3rd, Paris, 1962, 1: 94-101 (1963).

The mean value of the square of a normalized deviation function is taken as a measure of the degree of departure of an actual state from the equilibrium state, with the equilibrium distribution as weight function. It is shown that such a measure is, for some flows, connected with Tsien's classification of flow regimes. The irreversibility of the variation of certain physical quantities is related to the value of this measure. For each value of the measure there is a class of physical quantities behaving in an entropy-like manner. The transport equation of one of such quantity for a near to equilibrium state is described. (auth)

40072 A NEW APPROACH TO NONEQUILIBRIUM STATISTICAL MECHANICS OF GASES. J. E. McCune, G. Sandri, and E. A. Frieman (Aeronautical Research Associates of Princeton, Inc., Princeton, N. J.). Proc. Intern. Symp. Rarefied Gas Dyn., 3rd, Paris, 1962, 1: 102-14(1963).

A new technique for the study of multiple-time relaxation processes is applied to the case of a short-range (neutral) dilute gas. A virial expansion of the BBGKY hierarchy is combined with an expansion of the time derivative in such a way that explicit account is taken of both the fast and slow processes occurring. This expansion is made definite by the removal of secular terms on the fast time scale; the first condition for the removal of such secularities is Bogolubov's form of the Boltzmann equation. Generalized conditions for the attainment by a gas of such a kinetic stage are given. The difficulty of generalizing the kinetic equation to allow for three-body effects is discussed in the light of new developments. (auth)

40073 ON THE RELAXATION OF GASES TOWARD CONTINUUM FLOW. J. E. McCune, T. F. Morse, and G. Sandri (Aeronautical Research Associates of Princeton, Inc., Princeton, N. J.). Proc. Intern. Symp. Rarefied Gas Dyn., 3rd, Paris, 1962, 1: 115-35(1963).

A new method for obtaining kinetic equations from expansions of the BBGKY hierarchy was developed recently by Frieman and Sandri. This method takes advantage of the multiplicity of time scales appearing naturally in the hierarchy equations, and uses the freedom of these new time parameters to eliminate secular terms and thereby render the expansions uniformly valid for all times. The technique of introducing multiple time scales is also applicable to the Boltzmann equation and its various moments. For a perturbation in small spatial gradients at fixed Mach number it is shown that the second and third approximations to the distribution function necessarily must approach asymptotically the familiar Chapman-Enskog results if the expansion is to remain valid for large times. The moment equations asymptotically become the Navier-Stokes and Burnett equations in the corresponding approximations. This pattern follows to all orders. The major new result is to demonstrate the manner in which the various approximations to the distribution function asymptotically approach the Chapman-Enskog values on the fast time scale. To study in detail how this asymptotic damping of transients occurs, the Bhatnager, Gross, Krook collision model is investigated, and explicit forms of the transients in the pressure tensor and heat flow vector calculated through first order. (auth)

40074 SOUND PROPAGATION ACCORDING TO THE KINETIC THEORY OF GASES. L. Sirovich (New York Univ., New York) and J. K. Thurber. Proc. Intern. Symp. Rarefied Gas Dyn., 3rd, Paris, 1962, 1: 159-80(1963).

Sound propagation and the initial value problem in kinetic theory are investigated. Linearized forms of certain kinetic models suggested by Gross and Jackson are employed. The most general model contains three relaxation times and is capable of producing Euler, Navier-Stokes, Burnett, and thirteen moments equations. A study of the analytic continuation of the dispersion relations is made and some novel features are uncovered. One finds that kinetic models are unable to describe phenomena of higher than a certain wave number, the latter depending on the model chosen. It compensates for this by introducing an interesting but unphysical dispersion picture for higher wave numbers. It is further shown for one of the models that the phase speed of sound waves is a bounded function of the wave number. (auth)

40075 CALCULATION OF COLLISION INTEGRALS IN THE MOMENT EQUATIONS. Kurt Suchy (Universität, Marburg, Ger.). Proc. Intern. Symp. Rarefied Gas Dyn., 3rd, Paris, 1962, 1: 181-208(1963).

Calculation of the collision integrals in the moment equations is made using Weitzsch's ansatz for the velocity distribution functions, represented as an integral superposition of Gaussian distributions. Its weighting function must contain a finite number of velocity independent parameters for the treatment of problems with strong deviations from equilibrium. For weak deviations a series expansion yields Grad's expansion of the distribution function in tensorial Hermite polynomials. The moment equations with their collision integrals are established up to the third order and the transport cross sections occurring therein are calculated for inverse power interaction potentials. (auth)

40076 RAREFIED GAS DYNAMICS. VOLUME II. Proceedings of the Third International Symposium Held at Paris, 1962. J. A. Laurmann, ed. Advances in Applied Mechanics, Suppl. 2. Proc. Intern. Symp. Rarefied Gas Dyn., 3rd, Paris, 1962, 2: 1-529(1963). New York, Academic Press, 1963. $16.00.

Ionized gas flows, experiments and theory on transition flow, and experimental methods in rarefied gas flows are discussed. Separate abstracts are prepared for 4 of the 27 papers presented. One paper previously appeared in NSA (18: 30928). (C.E.S.)

For abstracts of individual papers see: 39443, 39446, 40703, and 40704.

40077 FOCUSING OF ELECTRON BEAMS IN CROSSED STATIC ELECTRIC AND MAGNETIC FIELDS. P. S. Farago (Univ. of Edinburgh). Proc. Roy. Soc. Edinburgh, A, 66: 1-19(1961-62).

In a crossed static homogeneous electric and magnetic field charged particles describing trochoidal orbits in a plane perpendicular to the direction of the magnetic field are focused, but a beam emitted by a point source in a finite solid angle spreads out indefinitely in the direction parallel to the magnetic field. The essential characteristics of trochoidal orbits can be preserved if the superimposed magnetic and electric fields are two-dimensional and orthogonal, such as derived from a vector potential, say, $A_x = A(y,z)$, $A_y = A_z = 0$, and a scalar potential $\Phi(y,z) = \text{const.}\, A(y,z)$. The focusing properties of such a field combination depend on the distribution of the magnetic field only. Following some general considerations, specific examples of double focusing field distributions are given, and the electron motion in one of them is treated in detail. (auth)

40078 EVENTS, LAWS OF NATURE, AND INVARIANCE PRINCIPLES. Eugene P. Wigner (Princeton Univ., N. J.). Science, 145: 995-9(Sept. 4, 1964).

The relation between events, laws of nature, and symmetry principles is discussed. The invariance principles and their uses are reviewed; approximate invariances are briefly considered. (D.C.W.)

40079 ON COHERENT AMPLIFICATION OF SPIN WAVES BY A BEAM OF CHARGED PARTICLES. V. G. Baryakhtar and Z. Z. Makhmudov (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Zh. Eksperim. i Teor. Fiz., 47: 593-7(Aug. 1964). (In Russian)

Amplification of spin waves in a ferromagnetic material due to coherent interaction between a charged particle beam and spin waves is investigated. The particle velocity in the beam has a longitudinal as well as transverse component relative to the external magnetic field. Amplification is especially great if the resonance condition is satisfied. For small particle densities in the beam the increment is proportional to $n^{1/3}$. (auth)

40080 PRINCIPLES OF MAGNETIC RESONANCE WITH EXAMPLES FROM SOLID STATE PHYSICS. Charles P. Slichter. Harper's Physics Series. New York, Harper & Row, 1963. 253p. $9.00.

The theory of magnetic resonance is presented, including: basic theory of magnetic resonance; magnetic interactions of electrons with nuclei; magnetic dipole broadening of rigid lattices; spin-lattice relaxation and motional narrowing of resonance lines; electric quadrupole effects; and electron spin resonance. (T.F.H.)

40081 ON THE DEFINITION OF DIMENSIONS AND UNITS IN DOSIMETRY. J. Fraenz (Physikalisch-Technische Bundesanstalt, Brunswick). p.83-9 of "Standards of Measurement of Ionizing Radiations." Paris, Gauthier-Villars and Cie, 1963. (In French)

The confusion present in the interpretation of the 1939 definition of roentgen is reviewed, and the definition proposed in 1962 by the I.C.R.U. is given and discussed. The relations between the magnitudes employed in general for the description of a radiation field and the dosimetric magnitudes are then briefly described. The radiation source produces a radiation field which produces physical or chemical effects on matter. The description of these concepts is considered. The absorbed dose rate, kerma rate, energy dose, and ion dose or exposure rate are discussed. (J.S.R.)

40082 PARAMAGNETIC RESONANCE OF DILUTE Gd^{+++} IN Pd IN PRESENCE OF RARE EARTH IMPURITIES. M. Peter. Chap. 28 of "Metallic Solid Metals." New York, W. A. Benjamin, Inc., 1963.

The conduction-electron polarization around localized magnetic impurities was investigated in Pd by means of a study of the paramagnetic resonance spectrum of dilute Gd in Pd. The sign of the average of the polarization is negative in the rare earths. The basic interaction is, therefore, not the atomic exchange interaction. The range of the polarization is unusually long in the Pd alloys. It is pointed out that the anisotropic polarization calculated by Gautier on the basis of Fletcher's band structure for Ni, would in part explain this long range, and that Wolff's calculation, which includes the electron-electron interaction, would further enhance the range. Susceptibility data on the dilute alloys are discussed. (Rev. Metal Lit., 21: No. 7, July 1964)

40083 THE SURFACE IONIZATION ION ENGINE. R. M. Worlock (Electro-Optical Systems, Inc., Pasadena, Calif.). 35p. (CONF-407-5)

From Electro Chemical Society, Toronto, May 1964.

Theoretical and practical aspects of electrostatic propulsion engines for spacecraft are presented. Experimental results obtained using W electrodes and Cs propellant are detailed. (T.F.H.)

40084 CYCLOTRON RESONANCE AND MAGNETO-OPTICAL RESONANCE. Benjamin Law (Massachusetts Inst. of Tech., Lexington and Cambridge). 27p. (CONF-626-1)

From American Physical Society, New York State Section Spring Meeting, Corning, New York, Apr. 1964.

Studies of semiconductors, metals, and semimetals by cyclotron and magneto-optical resonance techniques are reviewed. Results are given for graphite, Si, Ge, InSb, diamond, GaSb, Bi, and Cu. Two new developments in the field, the so-called combination resonance or transitions and the cross-field magneto-optical effect are discussed briefly. (A.G.W.)

Accelerators

40085 (CERN-64-35) A PULSED-BEAM TRANSPORT SYSTEM FOR THE EXTERNAL PROTON BEAM OF THE CERN PROTON SYNCHROTRON. B. Langeseth (European Organization for Nuclear Research, Geneva). July 2, 1964. 36p.

For the CERN neutrino beam, a small aperture beam transport system of pulsed quadrupole lenses and deflecting magnets was constructed for guiding and focusing the 28-Bev fast ejected proton beam onto a small external target. Main parameters, characteristics, construction details, and user's essential information are given. (auth)

40086 (LA-DC-6527) BEAM DYNAMICS CALCULATIONS FOR ALVAREZ-TYPE LINEAR ACCELERATORS. Marvin Rich (Los Alamos Scientific Lab., N. Mex.). [nd]. Contract W-7405-eng-36. 18p. (CONF-650-1)

From Linear Accelerator Conference, Madison, Wis., July 1964.

A computational procedure for linac beam dynamics is described; it is assumed that the axial electric field within a gap between drift tubes is spatially constant and zero within the drift tubes. Using Maxwell's equations and the axial field form, the off-axis electric and magnetic fields can be obtained as a power series in the radial co-ordinate. The electromagnetic fields obtained are then used for an approximate solution to the relativistic equations of motion for a particle within a gap. Comparisons of the procedure and an accurate numerical integration of the equations are given; agreement to about four significant figures in energy and phase was found after passage of particles through 250 gaps. (R.E.U.)

40087 (LA-DC-6528) A GREEN'S FUNCTION APPROACH TO THE CALCULATION OF DRIFT TUBE CAVITIES. M. Rich and W. M. Visscher (Los Alamos Scientific Lab., N. Mex.). [1967]. Contract W-7405-eng-36. 14p. (CONF-650-2)

From Linear Accelerator Conference, Madison, Wis., July 1964.

The method described involves the initial use of drift tube calculation problem symmetries to reduce Maxwell's equation to a single one. This is solved by use of a cylindrical Green's function which gives the fields inside a cylindrical conductor directly and exactly for a prescribed dipole disk (or tube) source with sinusoidal time dependence of arbitrary frequency. By integrating this Green's function an exact solution for the fields due to an arbitrary internal current distribution can be obtained. (J.R.D.)

40088 (LA-DC-6542) A NUMERICAL STUDY OF PARTICLE DYNAMICS IN A HIGH-ENERGY PROTON LINEAR ACCELERATOR. M. Jakobson and W. M. Visscher (Los Alamos Scientific Lab., N. Mex.). [1964]. Contract W-7405-eng-36. 20p. (CONF-650-4)

From Linear Accelerator Conference, Madison, Wis., July 1964.

The current status of a particle beam dynamical calculation is reported. A brief description of the method used in the calculation is presented along with discussions of the computer code and results. (J.R.D.)

40089 (LA-DC-6553) THE LASL MESON FACTORY. D. E. Nagle (Los Alamos Scientific Lab., N. Mex.). [nd]. Contract W-7405-eng-36. 22p. (CONF-650-3)

From Linear Accelerator Conference, Madison, Wis., July 1964.

Design work on a high-current, 800 Mev, proton linac

and associated experimental areas and equipment is described. A complete facility is planned, comprising experimental areas, office building, branch shops, data handling equipment, and high-level radiochemistry laboratories. Data concerning the facility and conceptions of its physical appearance are included. (J.R.D.)

40090 (LA-DC-6561) RF PHASE AND AMPLITUDE CONTROL. Robert A. Jameson (Los Alamos Scientific Lab., N. Mex.). [nd]. Contract W-7405-eng-36. 19p. (CONF-650-5)

From Linear Accelerator Conference, Madison, Wis., July 1964.

A description of a control design is presented. Basic specifications based on beam dynamics and power amplifier parameters are given along with comment and a general layout block diagram. Basic control loops are also described along with transfer functions and envelope responses. (J.R.D.)

40091 (NP-14336) A 5-Mv ELECTROSTATIC GENERATOR FOR PARTICLE ACCELERATION (thesis). Derk Wierts (Groningen, Netherlands. Rijksuniversiteit. [Natuurkundig Laboratorium]). 1964. 105p.

A brief review of electrostatic generators is given along with a description of the Groningen 5 Mv Van de Graaff accelerator and notes concerning accelerator design. Other discussions are included concerning regulation of accelerator voltages, design of the magnetic analyzer used with the Groningen accelerator, and maximum beam intensity parameters. (J.R.D.)

40092 (UCRL-11426) A SEPARATED 2.5- TO 2.8-Gev/c K^- BEAM AT THE BEVATRON. Joseph J. Murray, Janice Button-Shafer, Frank T. Shively, George H. Trilling, John A. Kadyk, Alan Rittenberg, Daniel M. Siegel, James S. Lindsey, and Deane W. Merrill (California. Univ., Berkeley. Lawrence Radiation Lab.). July 7, 1964. Contract W-7405-eng-48. 15p. (CONF-550-42)

From the International Conference on High-Energy Physics, Dubna, USSR, Aug. 1964.

The elimination of chromatic aberration in the optical system used to produce a separated K^- beam of 2.5 to 2.8 Bev/c from the Bevatron is discussed. Sextupole field magnets are not used; the mass slits are tilted severely so that a line along the apex of the slits makes an angle in the horizontal plane of only a few degrees with respect to the beam direction. With this arrangement, it is possible to design the beam optics so that stigmatic foci are formed nearly independent of momentum at the mass slits, thus eliminating the aberration. (R.E.U.)

40093 (UCRL-11477) OPERATION OF THE 88-INCH CYCLOTRON. Hermann Grunder and Frank Selph (California. Univ., Berkeley. Lawrence Radiation Lab.). Apr. 1964. Contract W-7405-eng-48. 25p. (CONF-452-44)

From American Physical Society, Washington, D. C., Apr. 1964.

Experimental facilities at the 88-inch Cyclotron as of May 1964 are briefly discussed. Characteristics of the beams are described, including intensity as a function of time, radial and vertical source positions, and emittance and the energy spread. Some data are presented on the distribution of machine time and on the availability of beams. (auth)

40094 SOURCE OF POLARIZED IONS. B. P. Adyasevich, V. G. Antonenko, Yu. P. Polunin, and D. E. Fomenko. At. Energ. (USSR), 17: 17-22 (July 1964). (In Russian)

A source of polarized ions, giving a current of about 0.1 μamp, was constructed. Background from unpolarized deuterons is 1 to 2% and from protons is 10 to 15%. The degree of alignment of the deuterons, appearing in the anisotropy of the angular distribution of α particles in the reaction $T(d,n)^4He$, is verified. The degree of alignment is equal to -0.326 ± 0.01, which agrees well with the theoretical value -0.328 for an orienting field of 10 Oe. Thus it may be concluded that the polarization of protons is ~50% and of deuterons ~33%. Cooling the hydrogen dissociator by liquid nitrogen doubles the intensity. (tr-auth)

40095 LONGITUDINAL INSTABILITY OF A CHARGED BEAM CIRCULATING IN ACCELERATOR OR IN A STORAGE CHAMBER WITH A FINITE WALL CONDUCTIVITY. A. A. Kolomenskii. At. Energ. (USSR), 17: 57-8 (July 1964). (In Russian)

It was previously shown that longitudinal instability of a charged cylindrical beam arises if the frequency of revolution of the particles $\omega(E)$ decreases with their energy E, i.e., for $d\omega/dE < 0$, and also for $E < E_{cr}$, i.e., for $d\omega/dE > 0$, although more weakly. An analysis of the longitudinal stability of a cylindrical beam was carried out, taking into consideration the finite value of the conductance of the chamber walls. Results of the analysis are presented; they confirm the occurrence of instability for nonzero resistance, permit the calculation of the time of instability development, and demonstrate the conditions for its suppression. (M.J.T.)

40096 GERMAN ELECTRON SYNCHROTRON DESY. Atomwirtschaft, 9: 293-40 (July 1964). (In German)

The German electron synchrotron DESY is described and its history reviewed. Topics covered include assembly and putting into operation of DESY, the first experiments, buildings, pre-acceleration and injection of the electron beam, power supply and cooling, radiation protection, installations for the observation of the electron beam in the synchrotron, radiation guidance and measurement, generation of external radiation, the accelerator magnet, the high-frequency acceleration system, central control arrangements, and the vacuum system. Diagrams and pictures are included. (M.C.G.)

40097 MODEL CALCULATION FOR THE CATCHING MECHANISM IN A BETATRON. L. Schmalz (Friedrich-Schiller-Universität, Jena, Ger.). Exptl. Tech. Physik, 12: 111-12 (1964). (In German)

The motion of an electron beam injected into a betatron was calculated, assuming a linear model during the first critical revolutions ($v \ll c$). Analytically, the beam was treated as a continuity with consideration of such factors as the radial focussing of the magnetic field, the space charge, and the toroidal shape of the enclosure. For a first approximation, the radius of the electron path was assumed to be so large that the effect of the electric field along the chord due to the space charge was negligible. (auth)

40098 THE ELECTRIC FIELD BETWEEN THE DEES OF A CYCLOTRON, ESTABLISHED BY A POTENTIAL SERIES. S. Hiekmann and H. Trautmann (Zentralinstitut für Kernforschung, Rossendorf, Ger.). Exptl. Tech. Physik, 12: 174-7 (1964). (In German)

The formula obtained by means of a conformable diagram for the field pattern between the dees of a cyclotron was replaced by a potential series. With that the disadvantage of parameter representation was eliminated. The potential course and the electric field strength could be stated explicitly as a function of place. (tr-auth)

40099 PARTICLE ACCELERATORS. M. Stanley Livingston (Harvard Univ., Cambridge, Eng.). ICSU

(Intern. Council Sci. Unions) Rev. World Sci., 6: 44-69 (Jan. 1964).

The development of accelerators is outlined, and the several concepts and principles of acceleration are reviewed with reference to specific accelerators. The locations and energies of existing accelerators are tabulated, together with some other pertinent data. Beam transport and use are briefly discussed, and future developments, particularly storage rings, are considered. (D.C.W.)

40100 WRONSKIANS AND BEAM PROFILE EQUATIONS FOR RELATIVISTIC ACCELERATED BEAMS. P. P. Starling (Rutherford High Energy Lab., Chilton, Berks, Eng.). J. Nucl. Energy, Pt. C, 6: 405-7(July-Aug. 1964).

A formalism for determining beam profiles is extended to include the case of accelerated relativistic beams. The Wronskian is defined, and it is shown to be a constant of the system for magnetic elements. Equations for paraxial accelerated beams and accelerated beams subjected to quadrupole focusing are also derived. (C.E.S.)

40101 A BEAM PULSE STRETCHER OF THE SYNCHRO-CYCLOTRON. M. H. Foss, R. W. Findley, and A. Suzuki (Carnegie Inst. of Tech., Pittsburgh). Nucl. Instr. Methods, 29: 282-8(Oct. 1964).

A r-f beam pulse stretcher was applied successfully to the 450-Mev synchrocyclotron. The beam pulses are stretched completely. The duty factors are almost unity for the long time scale and less than two for the nanosecond time scale due to the phase bunch. The beam loss is 30 to 40 percent of the bunched beam. (auth)

40102 A SEMI-EMPIRIC METHOD FOR CALCULATION OF THE EQUILIBRIUM DISTRIBUTION OF CHARGES IN A FAST ION BEAM. I. S. Dmitriev and V. S. Nikolaev (Moscow State Univ.). Zh. Eksperim. i Teor. Fiz., 47: 615-23(Aug. 1964). (In Russian)

A simple semi-empiric method is proposed for calculating the mean charge and equilibrium distribution of the charges of fast ions moving in solid and gaseous media. In agreement with experimental data, the number of ions in a beam with various charges is assumed to depend on two parameters and be described by a Gaussian curve. In order to evaluate the mean charge and width of the equilibrium distribution the generalized Bohr criterion is employed in conjunction with the statistical model of the ion and with some concrete experimental data. (auth)

40103 PRODUCTION OF LARGE ELECTRON CURRENTS IN ACCELERATORS. I. M. Samoilov and A. A. Sokolov. Zh. Tekhn. Fiz., 34: 1057-72(June 1964). (In Russian)

Experimental results are presented on the production of large electron currents in apparatus with spiral particle storage. Results are given for small and large injection currents. In the latter case, azimuthal effects of the space charge were observed, producing in part a high exit particle efficiency at the injector. It is shown also that the maximum stored current in the apparatus is limited by weak vertical focusing caused by the space charge. (tr-auth)

Astrophysics and Cosmology

Refer also to abstract 40175.

40104 PREDICTED FLUXES AND LINE INTENSITIES IN LATE-TYPE MODEL ATMOSPHERES. R. Cayrel and J. Jugaku (Carnegie Institution of Washington, Washington, D. C. and California Inst. of Tech., Pasadena). Ann. Astrophys., 26: 495-560(Nov.-Dec. 1963).

The determination of the chemical composition of stars requires the knowledge of the dependence of stellar line intensities and colors on temperature, surface gravity, and metal/hydrogen ratio. This dependence is often obtained with neglecting the photospheric structure which is replaced by one representative point (single-layer approximation). This dependence is tabulated by model atmosphere computations. A series of model atmospheres, representing main-sequence stars in the temperature range $\theta_{eff} = 0.7$ to 1.4, was computed with metal/hydrogen ratios from 0.01 to 1.0 times that in the sun. The predicted emergent fluxes in the continuous spectra are given. The strengths of weak lines are tabulated for eight elements for various excited levels and wavelengths. The various factors affecting the strengths of typical metallic lines when the metal abundance is decreased are discussed in detail. Approximation formulas are given. Theoretical luminosity and blanketing effects on the photoelectric B and V colors are also computed. (auth)

40105 ON THE FORMATION OF SOLAR M-REGION. J. N. Tandon (Univ. of Delhi). J. Atmospheric Terrest. Phys., 26: 785-7(July 1964).

A model for the M regions of the sun is proposed. (D.C.W.)

40106 THE ISOTOPIC COMPOSITION OF KRYPTON IN METEORITES. W. B. Clarke and H. G. Thode (McMaster Univ., Hamilton, Ont.). J. Geophys. Res., 69: 3673-9(Sept. 1, 1964).

The isotopic composition and amounts of krypton extracted from four stone meteorites and one sample of meteoritic troilite have been measured. For the two chondrites Bruderheim and Abee, and the troilite phase of Canyon Diablo, the isotopic composition of krypton was found to be different from the isotopic composition of krypton in the atmosphere. The krypton isotope anomalies can be explained by effects of present-day cosmic rays, i.e., spallation reactions on rubidium and strontium and neutron capture by bromine and selenium. (auth)

40107 ON A POSSIBLE CLASS OF GALACTIC RADIO SOURCES. D. W. Sciama (Dept. of Applied Mathematics and Theoretical Physics, Cambridge, Eng.). Monthly Notices Roy. Astron. Soc., 128: 49-61(1964).

Steady-state theory of the universe can be reconciled with the Cambridge counts of radio sources if a substantial fraction of the sources lie within the galaxy and have a certain set of properties. An astrophysical mechanism is described, which might give rise to such a distribution of galactic sources. The mechanism consists in the rotational instability of gravitationally contracting low-mass stars, and the consequent conversion of rotational energy into magnetic and relativistic particle energy. If the radio data are correct this scheme will work only if certain extreme conditions are satisfied, namely if: about 80 per cent of the galactic background emission is due to the sources rather than to emission from the interstellar gas; the amount of matter locked up in the sources is about the maximum permitted by dynamical arguments concerning the "missing matter" in the galaxy; and the distribution of radio sources is highly anisotropic at flux levels below about 0.1×10^{-26} w(c/s)$^{-1}$ m^{-2}. (auth)

40108 ON DEPARTURES FROM LOCAL THERMODYNAMIC EQUILIBRIUM IN THE SOLAR ATMOSPHERE. Brian Warner (London Univ.). Monthly Notices Roy. Astron. Soc., 128: 63-72(1964).

Using curve of growth methods the variation of apparent excitation temperature, θ^* (= 5040/T*), with excitation potential of lines used is compared for the iron group atoms. No significant differences were detected. The curves of growth for all iron group atoms are similar. A theory is developed explaining quantitatively the observed difference between θ^* and the electron temperature, θ. This difference occurs because of the stratified nature of the solar atmosphere, not because of non-LTE (local thermodynamic equilibrium) conditions; in fact θ^* does not have any physical reality as a temperature. It is concluded that any non-LTE phenomena in the photosphere produce insignificant errors in the abundance determinations. (auth)

40109 ON THE CHEMICAL COMPOSITION OF THE SOLAR CORONA. Stuart R. Pottasch (Kapteyn Laboratorium, Groningen, Holland). Monthly Notices Roy. Astron. Soc., 128: 73-92(1964).

The abundance of nine elements is determined relative to hydrogen, using the observations of the forbidden lines in the corona obtained principally at the eclipse of 1952 February 25. The errors inherent in the analysis (those of observation, physical parameters, and theoretical assumption) are discussed in detail. An empirical method is developed for finding the total abundance of an element when only a single stage of ionization is observed. The results indicate disagreement with the photospheric abundances but agreement with the meteorite compositions. (auth)

40110 ORIGIN OF THE LIGHT ELEMENTS. Henri E. Mitler (Smithsonian Astrophysical Observatory and Harvard Coll. Observatory, Cambridge, Mass.). Phys. Rev., 136: B298-?(Oct. 12, 1964).

It is shown that the observed isotopic abundances of Li, Be, and B can be explained by their spallation in small, prototerrestrial bodies. Spheres of arbitrary composition and radius are irradiated by protons; approximate expressions are found for the solar-flare proton spectrum, the spallation cross sections, and neutron production. A new approximation is made for the effect of the fast neutrons. It is then found that the present day proton flux is too soft to give the desired results reasonably, and that a mean proton energy of 300 Mev is necessary to get the observed isotopic ratios. The results are not sensitive to the composition, and the measured Li, Be, and B abundances can be obtained by taking dry silicate spheres of about 140 m for the protoasteroidal bodies. In order to obtain the observed D/H ratio from the irradiation, however, it is necessary to add 10% H_2O. The measured crustal abundances of Li, Be, and B lead to different values for D/H and for the depletion of ^{157}Gd for the earth and for asteroids, contrary to observation. These discrepancies disappear if it is assumed that Li, Be, and B were concentrated tenfold in the earth's crust. The different isotopic ratios found for terrestrial and meteoritic material are consistent with this model, and enable us to calculate the $^7Li/^6Li$ ratios to be expected on the other planets. (auth)

40111 THE NEUTRINO IN THE UNIVERSE. Tibor Nagy (Loránt Eötvös Univ., Budapest). Postepy Fiz., 15: 133-40(1964). (In Polish)

Recent theories suggest that the neutrino plays an important role in cosmology. The difficulty in attempting to solve this problem arises from the choice of recording devices to be employed in physical and astronomical problems involving neutrinos. The theories assume that neutrinos are generated during the early stages of the formation of stars. If during that period the temperature exceeded 10^9 °K, the formation of muon neutrinos could have been expected. The possibility of a neutrino energy density exceeding the energy density of matter at rest is discussed in terms of Friedmann's model and the fluctuation hypothesis of the universe. Proof of the presence of muon neutrinos would justify the assumption that the universe in its early stages might have reached temperatures in excess of 10^9 °K. Presence of anti-stars could be detected by demonstrating the presence of antineutrinos. Methods used for measuring the neutrino flux are reviewed. (TTT)

40112 THE DIRECTION OF TIME AND THE EQUIVALENCE OF "EXPANDING" AND "CONTRACTING" WORLD-MODELS. D. L. Schumacher (Cornell Univ., Ithaca, N. Y.). Proc. Cambridge Phil. Soc., 60: 575-9 (July 1964).

It is assumed initially that only the increase of entropy defines locally the sense of advance of time. This assumption, together with the feature of global coherence of statistical processes, which is provided by the cosmic line-element, imply that there is a unique way of associating the standards with the cosmic statistical processes. There is hence a connection between the sense of divergence of geodesics of fundamental observers and the cosmic time-sense. This is in keeping with the unmodified conservation laws of gravitation and the analogous adiabatic conservation law quite generally without dependence on the explicit form of the line element. These remarks correspond exactly to consequences of the elliptic model in the case of de Sitter space, obtained by entirely separate geometrical considerations. A remark is made with regard to the irreversibility associated with quantum measurement. (auth)

40113 MEASUREMENT OF THE GRAVITATIONAL RED SHIFT WITH THE MÖSSBAUER EFFECT. T. E. Cranshaw (Atomic Energy Research Establishment, Harwell, Berks, Eng.) and J. P. Schiffer. Proc. Phys. Soc. (London), 84: 245-56(Aug. 1964).

The shift in frequency of electromagnetic radiation as it passes through a difference in gravitational potential has been measured by use of the Mössbauer effect in ^{57}Fe. The result is 0.859 ± 0.085 times the value predicted by Einstein's theory of relativity, the error being a standard deviation. The discrepancy is most likely due to chance since the probability of obtaining a deviation of at least this magnitude is 10%. (auth)

40114 THE CONTRACTION OF GRAVITATING SPHERES. H. Bondi (London Univ.). Proc. Roy. Soc. (London), Ser. A, 281: 39-48(Aug. 25, 1964).

Ideas associating an invariant integral of the energy invariant with the number of nucleons in a gravitating body are shown to be fallacious, and that these ideas therefore do not provide a means of following through the contraction of such a body. It is shown how the full field equations of general relativity give a feasible and rigorous method of examining contracting models. Schwarzschild-type coordinates are introduced and are used to examine the slow adiabatic contraction of a sphere of constant density. The particle paths are found and the pressure-density relation permitting such slow adiabatic contraction is examined. It is shown that the simple $4/3$ power law of Newtonian theory has to be replaced by a steeper dependence of pressure on density for high gravitational potentials. Radiation coordinates are introduced to examine radiating contracting systems, and equations fully specifying such a system are obtained. A simple example is given in outline to illustrate the method. (auth)

40115 QUASI-STELLAR DIAMETERS AND INTENSITY FLUCTUATIONS. James Terrell (Los Alamos Scientific

Lab., N. Mex.). Science, 145: 918-19(Aug. 28, 1964). (LADC-6470)

It is shown that there are relativistic limits on the fluctuations in brightness, which may be observed for a large spherical source, and also for more general sources, so that quasi-stellar objects are probably no more than light-days in size. There is thus a possibility that they may be close to our galaxy. (auth)

40116 SOLAR ACTIVITY DURING THE FIRST SIX MONTHS OF THE INTERNATIONAL YEARS OF THE QUIET SUN. Helen W. Dodson, E. Ruth Hedeman, and Frederic L. Stewart (Univ. of Michigan, Ann Arbor). Science, 145: 1050-2(Sept. 4, 1964).

The results of observations of solar activity in the first six months of 1964 are presented. In April, the monthly mean relative sunspot number dropped below ten for the first time in the declining phase of the present sunspot cycle. The development of new cycle activity was followed. (D.C.W.)

Atomic Physics

Refer also to abstracts 39446, 39803, and 39992.

40117 (EUR-1643.e(p.157-62)) SOME REMARKS ON BROUT-VISSCHER RESONANCES. J. Peretti and G. Riccobono (European Atomic Energy Community. Joint Nuclear Research Center, Ispra, Italy).

The resonance modes for the lattice vibrations of a harmonic crystal containing a heavy substitutional impurity were studied because of the resonance in the inelastic scattering of diagnostic slow neutrons from the crystal. The resonance modes are shown to exist in finite crystals due to the inherent anharmonicities. (R.E.U.)

40118 (NASA-TN-D-2484) SEMICLASSICAL CALCULATION OF THE DIFFERENTIAL SCATTERING CROSS SECTION WITH CHARGE EXCHANGE: CESIUM IONS IN CESIUM VAPOR. John W. Sheldon (National Aeronautics and Space Administration. Lewis Research Center, Cleveland). Sept. 1964. 38p.

The differential scattering cross section of an ion in its parent gas is calculated for an inverse fourth attractive (polarization) potential. The effect of charge exchange is included. The ion and atom paths during collision are computed classically, but the results of quantum mechanical charge-exchange probability calculations are used. Expressions are given for the range of energy and scattering angle over which this semiclassical approach is valid. The differential cross section is shown to have a maximum near an apparent scattering angle of 180°. Approximate expressions are given for the value of the cross section at the maximum and the scattering angle at which it occurs. Values of the differential cross section for cesium ions in cesium vapor are obtained by using the results of total charge-exchange cross section and atomic polarizability measurements. These calculations are expected to be valid for cesium ion-atom collision energies between 0.025 and 1000 electron volts. The relation between total cross section, charge-exchange cross section, and diffusion cross section is discussed. The determination of the total cross section from a scattering chamber type experiment is presented and compared with experiments. (auth)

40119 (NRL-6085) COULOMB APPROXIMATION OSCILLATOR STRENGTHS OF SPECTRAL LINES FROM LIGHT AND MEDIUM ELEMENTS. H. R. Griem (Maryland. Univ., College Park and Naval Research Lab., Washington, D. C.). Feb. 28, 1964. 24p. (AD-603312)

A comprehensive table of absorption oscillator strengths for many spectral lines from various ionization stages of most elements between, and including, Li and Ca, which were calculated with the Coulomb approximation for the radial matrix elements assuming LS-coupling, is given. An average accuracy of 30 percent is suggested for visible lines emitted from neutral atoms. For ultraviolet lines, larger errors must be expected, with the accuracy improving as the degree of ionization increases. Absorption oscillator strengths for the lines in many of the strongest multiplets of the various spectra are also included in the table. (auth)

40120 (TID-21083) STATISTICAL MECHANICS OF THE HEISENBERG ANTIFERROMAGNET. H. R. Carleton (Sperry Rand Corp. Sperry Rand Research Center, Sudbury, Mass. and Cornell Univ., Ithaca, N. Y. Lab. of Atomic and Solid State Physics). May 1964. Contract AT(30-1)-2391. 187p. (SRRC-RR-64-35)

The thermodynamic properties of the Heisenberg antiferromagnet are computed in the random phase approximation (RPA) and compared to the elementary spin-wave theories that are valid only at low temperatures. A comparison of the theoretical results with experimental measurements of the sub-lattice magnetization of manganese fluoride indicates that the RPA behaves similarly to the Weiss molecular field theory near absolute zero. The validity of these theories is then tested by carrying out a time dependent diagrammatic expansion, using semi-invariant techniques. An expansion valid in the high density limit leads to a summation of certain infinite classes of diagrams in which the Weiss molecular field theory and the spin-wave corrections are obtained to zero and first order in the expansion. The calculations are extended to include partial corrections to the ground-state energy due to spin-wave interactions and compared with the results of other workers. It is shown that a consistent expression for the sub-lattice magnetization, which includes spin-wave corrections, can only be obtained by proper renormalization of the high density theory. This renormalization involves the calculation of spin-wave interactions to arbitrarily high order. An approximation to these interactions is obtained by a factorization procedure, and the similarities and differences between this theory and RPA are examined. (auth)

40121 THE RADIATIVE RECOMBINATION COEFFICIENTS OF THE HYDROGEN ATOM. William J. Boardman (High Altitude Observatory, Boulder, Colo.). Astrophys. J., Suppl. Ser., 9: 185-92(Aug. 1964).

This paper uses a formula derived for the photoionization cross sections of the hydrogen atom as a basis for a numerical computation of the radiative recombination coefficients. Tables of the computed results are given for all angular momentum states up to and including n = 10, l = 9 over a temperature range 10^3 to 10^6°K. (auth)

40122 AVERAGE RECOMBINATION GAUNT FACTORS. Helen P. Glasco and Harold Zirin (High Altitude Observatory, Boulder, Colo.). Astrophys. J., Suppl. Ser., 9: 194-200(Aug. 1964).

The average hydrogenic Gaunt factors calculated for principal quantum numbers n = 1 to 15 for all individual l-values, are tabulated for temperatures from 2,500 to 2,560,000°K. (auth)

40123 ON THE ENERGY SPECTRUM OF METALLIC NIOBIUM. I. G. Shveitser, I. Ya. Nikiforov, and V. P. Sachenko (Rostov-on-Don State Univ., USSR). Izv. Akad. Nauk SSSR, Ser. Fiz., 27: 797-800(May 1964). (In Russian)

The energy levels of metallic niobium were calculated

with the use of 13 plane waves after obtaining the Fourier coefficients of the potential V_j, the orthogonality coefficients $A_{ni}(k)$, and the atomic eigenvalues as functions of the atomic number Z. The Nb values required for the calculations were derived from the known values for Mo. The position of the energy levels in Nb differs significantly from the position of these levels in Mo. The Γ_1 level of s-symmetry is closer to the Fermi surface in Nb. The Γ_{12} and $\Gamma_{25'}$ levels, which have d-symmetry, are also in an unfilled part of the band in Nb, but are significantly lower and closer to each other in Nb than in Mo. In contrast to molybdenum, the H_{12} level of d-symmetry in Nb is in an unfilled portion of the band. These calculated differences in the energy levels of Mo and Nb are used to provide a qualitative explanation of the differences observed in the emission L_{β_2} spectra and the L_{III} absorption spectra of Nb and Mo. The interpretation of the x-ray spectra is satisfactory even though only 13 plane waves were used as a first approximation in calculating the energy levels in Nb and Mo. (TTT)

40124 EFFECTS OF ELECTRON CORRELATION IN X-RAY AND ELECTRON DIFFRACTION. L. S. Bartell and R. M. Gavin, Jr. (Ames Lab., Ames, Iowa). J. Am. Chem. Soc., 86: 3493-8(Sept. 5, 1964). (IS-838)

The theory of X-ray and electron diffraction by atoms is examined from the standpoint of one-electron and two-electron operators. Elastic scattering depends on one-electron operators and hence may be used to determine the density of electrons about nuclei, a one-electron property. Inelastic scattering by atoms possessing more than one electron depends on the distance between planetary electrons. Consequently, the mean density of electrons about other electrons, an important two-electron property, can also be determined from diffraction experiments. A procedure for deriving the electron-nuclear and electron-electron radial distribution functions $D(r_i)$ and $P(r_{ij})$ from scattered intensities is presented. It is shown how these functions may be used to calculate electronic energies in atoms, including correlation energy. Properties of $D(r_i)$ and $P(r_{ij})$ are illustrated, using helium as an example. An extension of the treatment to molecules and crystals is briefly discussed. Comparisons are made of elastic and inelastic scattering factors calculated from Hartree-Fock wave functions and from wave functions explicitly including electron correlation. Effects of correlation on inelastic factors are found to be appreciable. The influence of correlation on elastic form factors and on Bragg reflection intensities for well-ordered crystals is insignificant, however. The relationship between Debye's 1915 picture of the X-ray scattering process and the very different picture developed in conventional treatments of X-ray crystallography is pointed out. This comparison helps to elucidate the role of electron correlation in X-ray and electron diffraction. (auth)

40125 MANY-CENTER WAVEFUNCTIONS FOR THE HYDROGEN MOLECULE AND THE HYDROGEN MOLECULAR ION. James R. Hoyland (Argonne National Lab., Ill.). J. Chem. Phys., 40: 3540-7(June 15, 1964).

Many-center wavefunctions for the hydrogen molecule and the hydrogen molecular ion were constructed using basis sets composed of either 1s orbitals or spherical Gaussians. Emphasis was placed on minimization of the total molecular energy with respect to all available nonlinear parameters. In the case of the s-orbital basis, all the many-center integrals were computed without resort to approximation techniques. It was concluded that the basis set of spherical Gaussians is superior to that of 1s orbitals and that further work with these functions may prove fruitful. (auth)

40126 EVOLUTION OF MOLECULAR SYSTEMS AND THE SEPARATION OF ELECTRONIC AND NUCLEAR MOTIONS. David Micha (Uppsala Univ.). J. Chem. Phys., 41: 1947-51(Oct. 1, 1964).

A time-dependent approach to the study of molecular systems is used to analyze the interaction between the electronic and nuclear motions. The set of coupled evolution equations for the nuclei, resulting from this treatment, is solved in a first-order perturbation approximation to obtain the decoupling of electronic and nuclear motions and to give conditions for its validity. A comparison was made with an adiabatic approximation treatment of the evolution equations and with the Born-Oppenheimer approximation, paying attention to the initial suppositions and to the restrictions in the different cases. (auth)

40127 PROPERTIES OF FIRST-ROW ATOMS AND IONS CALCULATED FROM "EMPIRICAL" NONRELATIVISTIC ENERGIES. Frank O. Ellison (Carnegie Inst. of Tech., Pittsburgh). J. Chem. Phys., 41: 2018-20(Oct. 1, 1964).

Electron-electron repulsion energies $\bar{C}$, electron-nuclear attraction energies $\bar{L}$, and nuclear magnetic shielding constants σ for atoms and ions with number of electrons n = 2 10 and nuclei of charge Z = n − 1 to 10, calculated from empirical nonrelativistic energies E for isoelectronic series, are reported and compared with theoretically computed values. (auth)

40128 DISSOCIATIVE IONIZATION OF N_2 AND N_2O BY RARE-GAS ION IMPACT. William B. Maier, II (Univ. of Chicago). J. Chem. Phys., 41: 2174-89(Oct. 1, 1964).

Cross sections for the reactions $Ne^+ + N_2 \rightarrow N^+ + N + Ne$, $Kr^+ + N_2O \rightarrow O^+ + N_2 + Kr$, $Ar^+ + N_2 \rightarrow N^+ + N + Ar$, and $Kr^+ + N_2O \rightarrow N + NO^+ + Kr$, were measured as functions of primary ion kinetic energy. All of these reactions exhibit thresholds, and a semiempirical formula is fitted to the data near to the threshold energies. Despite the isoelectronic character of the products of $Kr^+ + N_2O \rightarrow O^+ + N_2 + Kr$ and $Kr^+ + N_2O \rightarrow N + NO^+ + Kr$, their behavior differs in that the former reaction proceeds by the energetically most favorable channel while the latter does not; the reaction $Kr^+ + N_2O \rightarrow N + NO^+ + Kr$ is energetically allowed for all primary ion kinetic energies but appears not to proceed below kinetic energies of about 2.4 ev in the center-of-mass coordinate system. The cross sections of reactions involving only atomic products do not exhibit any striking, qualitative differences from those cross sections involving molecular products. (auth)

40129 LOW-LYING ENERGY LEVELS OF TRIVALENT AMERICIUM. W. T. Carnall, P. R. Fields, and B. G. Wybourne (Argonne National Lab., Ill.). J. Chem. Phys., 41: 2195-6(Oct. 1, 1964).

The magnetic dipole oscillator strength for the transition from the ground state of Am^{3+} to the predicted level at ~17,000 cm^{-1} was computed to be $\sim 5 \times 10^{-10}$. Measurements of the solution absorption spectrum of Am^{3+} were made using a highly purified sample at a concentration of ~0.2M with a path length of 2.5 cm. A very weak, broad absorption band was found near the predicted energy with an oscillator strength of 2.4×10^{-7}. The transition is believed to be an extremely weak electric dipole transition. Several additional features were also observed in the absorption spectra at high Am^{3+} concentrations. A very weak band was seen in HNO_3 solution to the high-energy side of the lowest J = 6 level. It was also found that the band near 22,000 cm^{-1}, which has been identified as containing components attributable to two J = 2 states, is, in contrast to the other bands, unusually sensitive to changes in the environment of the Am^{3+} ion. (P.C.H.)

40130 EFFECT OF PRESSURE ON THE ELECTRIC FIELD GRADIENT IN METALLIC ANTIMONY. W. J. O'Sullivan and J. E. Schirber (Sandia Lab., Albuquerque, N. Mex.). J. Chem. Phys., 41: 2212-13(Oct. 1, 1964).

The results of pressure dependence measurements of the electric field gradient (EFG) at an Sb nuclear site in antimony metal are reported. The $^{121}Sb(1/2 \rightarrow 3/2)$ nuclear quadrupole resonance (NQR) frequency was followed as a function of hydrostatic pressure to 3.5 kbar. The Sb EFG has axial symmetry and can be completely described by the field gradient component along the c axis (q); however, q requires four independent variables such as V, T, c/a, and z, for a complete description. It was concluded that a knowledge of the temperature and pressure dependence of the EFG in Sb, even if coupled with the pressure and temperature dependences of the three lattice parameters V, c/a, and $z[(dz - dP)_T$ has not yet been determined], sheds little light upon the explicit dependences involved. (P.C.H.)

40131 SPIN-EXCHANGE COLLISIONS BETWEEN RUBIDIUM AND CESIUM ATOMS. Teinosuke Kanda and Takumi Minemoto (Kobe Univ., Japan). J. Phys. Soc. Japan, 19: 1248(July 1964).

The spin-exchange cross section of Rb–Cs collisions was obtained. The double resonance technique was used. In a static field of 2 gauss along the x-direction (optical axis) an optically pumped polarization of Cs by a weak r-f field of 700 kc applied in the y-direction was observed. Two strong r-f fields of 934 and 1400 kc resonating to ^{85}Rb and ^{87}Rb, respectively, were applied in the Z-direction. (C.E.S.)

40132 INTERACTION POTENTIALS BETWEEN EQUAL ATOMS (IONS) AT INTERMEDIATE AND SMALL NUCLEAR SEPARATIONS. APPLICATION TO He–He AND Ar–Ar. K. Guenther (Zentralinstitut für Kernforschung, Rossendorf, Ger.). Kernenergie, 7: 443-51(June-July 1964).

A procedure was established for the calculation of interaction potentials by considering the shell structure of two interacting atoms. A general method was established requiring only the detailed energetic treatment of the mutual penetration of equal shells, in which the already destroyed outer shells may be omitted. A statistical method was used for calculation of the interaction energy of two shells and the statistical perturbation was based on the Hartree-Fock electron density. This method, originally established for small overlaps in electronic clouds (ion crystals), gave very good results for the He–He overlap interaction even if the overlap were considerable. The Ar–Ar interaction potential was calculated to illustrate the method. (M.C.G.)

40133 THE FREE-FREE TRANSITIONS OF THE NEGATIVE HYDROGEN ION IN THE EXCHANGE APPROXIMATION. T. L. John (University Coll. of South Wales and Monmouthshire, Cardiff). Monthly Notices Roy. Astron. Soc., 128: 92-102(1964).

The free-free absorption cross section of H^- is calculated using exchange wave functions. Exchange effects are shown to reduce the cross-section 30 to 40 per cent at solar temperatures. (auth)

40134 STUDY ON SECONDARY ELECTRONS. I. ON THE ENERGY SPECTRUM OF SECONDARY ELECTRONS PRODUCED IN MATTER BY 320-kvp WHITE X RAYS. K. Hoshino, T. Inada, K. Kawashima, Y. Takaku, S. Sakata, and H. Matsuzawa (National Inst. of Radiological Sciences, Chiba, Japan). Nippon Igaku Hoshasen Gakkai Zasshi, 22: 306-15(July 25, 1962). (In Japanese)

The energy loss of monochromatic electrons (624-kev) in various media and the secondary electron spectrum generated in media by 320-kvp x rays were measured with a double-focusing magnetic beta-spectrometer having high resolution. Only the energy spectrum of electrons emerging in the same direction as the incident x-ray beam is described in this presentation. The average energy loss of 624-kev electrons in polyethylene foil agreed with the theoretical value. For various other media (Pb, Cu, Al, and Lucite) exposed to white x rays the forward emission energy spectra of electrons were not so different from each other, but the electron flux (the total number of electrons passing through a unit area) increased rapidly with increasing atomic number of medium. The average LET of these secondary electrons produced by 320-kvp x rays in Lucite was estimated at 0.73 kev/μ. Calculations for the secondary electron spectra were carried out by an approximation procedure which took into consideration the initial electron spectrum generated by 320-kvp x rays, the effective volume for the electrons capable of passing through the area of interest, and the effect of the slowing down of electrons. These calculated results were compared with the experimental ones and were in good agreement with them for the recoil electrons in the Compton effect in Lucite. Therefore, in practice, it seemed reasonable to estimate the secondary electron spectrum by the approximation procedure described. (BBB)

40135 CALCULATION OF THE LITHIUM ATOM BY THE HARTREE-FOCK METHOD WITH COMPLETE SELF-CONSISTENCY. A. V. Ivanova and A. N. Ivanova. Opt. Spectry. (USSR) (English Transl.), 16: 499-502(June 1964). Translated from Optika i Spektroskopiya, 16: 917-24(June 1964).

A system of Hartree-Fock equations with complete self-consistency was solved for the lithium atom in the ground state and several excited states. The method and the results are given and the physical effects of their nonlinearity were investigated. The values of the ionization potentials, the total energy, and the oscillator strengths were calculated using Hartree-Fock functions with and without self-consistency. Comparison of the results obtained for lithium with different wave functions permits an estimate of the effect of core deformation by an optical electron on the above-mentioned quantities. (auth)

40136 PHOTOIONIZATION OF OPTICAL ELECTRONS IN THE IONS N(V) AND O(VI). A. V. Ivanova. Opt. Spectry. (USSR) (English Transl.), 16: 502-4(June 1964). Translated from Optika i Spektroskopiya, 16: 925-8(June 1964).

The photoionization cross sections for transition of an optical electron from the ground state and certain excited states to the continuous spectrum with energies from the threshold up to hundreds of electron volts were calculated for the ions N(V) and O(VI). The optical electron wave functions (in the discrete and continuous spectra) were calculated by the Hartree-Fock method. It is shown that the absorption of light by ions can be described by a simple model without considering polarization of the remaining optical electrons. The accuracy of the method of calculating photoionization cross-sections using the Hartree-Fock function is calculated. (auth)

40137 EXCITATION FUNCTIONS OF THE SPECTRAL LINES OF CESIUM. I. P. Zapesochnyi and L. L. Shimon. Opt. Spectry. (USSR) (English Transl.), 16: 504-7(June 1964). Translated from Optika i Spektroskopiya, 16: 929-35(June 1964).

The excitation functions of 25 lines belonging to the principal, sharp, diffuse, and fundamental series of the cesium

atom were measured at low vapor pressure. The spectrum was excited by a low-density beam of mono-energetic electrons. Patterns of behavior were established for the excitation functions of lines of all series. Secondary maxima were found in the excitation functions of the resonance lines. No differences were observed in the behavior of the excitation functions of the components of doublets. (auth)

40138 THE ISOTOPIC SHIFT IN THE SPECTRUM OF THE SINGLY IONIZED SAMARIUM ATOM. A. R. Striganov and N. A. Kulazhenkova. Opt. Spectry. (USSR) (English Transl.), 16: 507-9(June 1964). Translated from Optika i Spektroskopiya, 16: 936-40(June 1964).

The isotopic shift between components of even-even isotopes of samarium was measured for 8 lines of Sm II, using separated isotopes. The relative isotopic shift pattern was different for lines with negative and positive displacements. It was established that the isotopic shift in $4f^{5}5d6s$ levels was twice as great as that in $4f^{6}6s$ levels. This effect is related to the way in which the 6s electrons are screened. By means of the isotopic shift data, the electronic configurations of 28 upper levels were found. (auth)

40139 COLLISIONS OF ELECTRONS WITH LITHIUM ATOMS IN THE STRONG-COUPLING APPROXIMATION. E. M. Karule and R. K. Peterkop. Opt. Spectry. (USSR) (English Transl.), 16: 519-21(June 1964). Translated from Optika i Spektroskopiya, 16: 958-62(June 1964).

The effective cross sections of elastic scattering and excitation of the lithium atom by electrons with energies of 2–3 ev were calculated. The strong coupling of the ground and first excited states of the atom and the exchange of incident and optical electrons were taken into account. A system of integro-differential equations was solved numerically with the BESM-2. The effective cross sections of diffusion and viscosity were also calculated. The total calculated cross section of collisions was 1.7–1.8 times less than the experimental data. (auth)

40140 ANGULAR MOMENTUM COMPENSATION IN NARROW LINE WIDTH FERRIMAGNETS. R. C. Lecraw, J. P. Remeika, and H. Matthews (Bell Telephone Labs., Inc., Murray Hill, N. J.). Phys. Letters, 12: 9-10(Sept. 1, 1964).

The anisotropy field, effective g factors, and total magnetization of europium iron garnet containing gallium were measured at 4.2°K. The results showed that the system has simultaneously large g factors and narrow line widths. A strong preference of substituted Ga^{3+} ions for the tetrahedral sites in Eu IG was noted, together with domination of Fe^{3+} ions in tetrahedral sites over those in octahedral sites in determining the exchange field at the Eu^{3+} sites. (D.C.W.)

40141 OPTICAL ABSORPTION OF FERRO- AND ANTIFERROMAGNETIC EUROPIUM CHALCOGENIDES. G. Busch, P. Junod, and P. Wachter (Eidgenossische Technische Hochschule, Zurich). Phys. Letters, 12: 11-12(Sept. 1, 1964).

Absorption measurements were made on EuO, EuS, EuSe, and EuTe at temperatures above and, for EuO and EuS, below the Curie point. EuO and EuS were found to retain an absorption edge below the Curie point. In EuO the absorption edge shifted to higher energies between room temperature and 90°K, but shifted to lower energies with decreasing temperature below room temperature due to spontaneous magnetization. An applied magnetic field increased the shift at lower temperatures. Similar effects were also observed in EuS. (D.C.W.)

40142 A NOTE ON KAC'S 1-DIMENSIONAL ISING MODEL. R. M. May (Univ. of Sydney). Phys. Letters, 12: 15-16(Sept. 1, 1964).

It is shown that the usual two-dimensional Ising problem is identical with a certain one-dimensional problem.. (D.C.W.)

40143 OBSERVATIONS OF TRANSITIONS BETWEEN STATIONARY STATES IN A ROTATING MAGNETIC FIELD. William Happer, Jr. (Princeton Univ., N. J.). Phys. Rev., 136: A35-42(Oct. 5, 1964). (PUC-1964-139)

The stationary states of an atom in a combined static and rotating magnetic field were investigated by using two frequency transitions in an atomic-beam machine. Very accurate measurements of a strong r-f magnetic field may be made by inducing transitions between the stationary states with a small tickling r-f field. The relaxation of the selection rules associated with the z component of angular momentum makes normally forbidden hyperfine transitions visible. (auth)

40144 TWO-PHOTON PROCESSES IN COMPLEX ATOMS. J. D. Axe, Jr. (International Business Machines Corp., Yorktown Heights, N. Y.). Phys. Rev., 136: A42-5 (Oct. 5, 1964).

The off-diagonal matrix elements of the polarizability operator when operating within an l^{N} configuration of a complex atom can be approximately written in simple tensor-operator form. The resulting expressions are discussed in terms of two-photon absorption and the recently observed electronic Raman scattering in the trivalent rare-earth ions. (auth)

40145 SPIN EXCHANGE IN A CESIUM-ELECTRON SYSTEM. L. C. Balling and F. M. Pipkin (Harvard Univ., Cambridge, Mass.). Phys. Rev., 136: A46-53(Oct. 5, 1964).

A spin-exchange optical pumping experiment to study collisions between cesium atoms and quasifree electrons is reported. In this experiment, electrons in a weak magnetic field were polarized through spin-exchange collisions with optically pumped cesium atoms. The cesium-electron collisions were the principal source of the electron-resonance linewidth, and they also gave rise to a shift in the center frequency of the electron resonance. The magnitudes of the linewidth and frequency shift depend upon the two-body scattering amplitude for elastic collisions, the cesium polarization, and the cesium density. From measurements of the electron linewidth and the frequency shift, a value is derived for the electron-cesium spin-flip cross section. The spin-flip cross section at 20°C is found to be approximately 3.5×10^{-14} cm^2. The expressions for the linewidth and frequency shift due to spin-exchange collisions of electrons with alkali-metal atoms are generalized to cover the case where there is a spin-orbit interaction between the electron-alkali-metal-atom systems. (auth)

40146 ELECTRONIC g FACTOR OF RUBIDIUM. Raymond L. Driscoll (National Bureau of Standards, Washington, D. C.). Phys. Rev., 136: A54-7(Oct. 5, 1964).

Frequencies corresponding to Zeeman transitions in an optically pumped rubidium-87 sample were measured relative to the free-precession frequency of protons in a spherical water sample. Observations were made at 12 and 6 G in a compensated solenoid. On the basis of accepted theory for the separation of energy levels in a magnetic field, the ratio of g factors for rubidium electrons and protons was found to be 658.2323 ± 0.0007. It follows that the electronic g factor for rubidium is 25 ± 1 parts per million higher than the g factor for the electron in the hydrogen ground state. This result is combined with ratios of alkali g factors measured in atomic beam experiments to give the g factors for other alkalis. (auth)

40147 ROTATIONAL MAGNETIC MOMENTS OF THE ALKALI MOLECULES. R. A. Brooks, C. H. Anderson, and N. F. Ramsey (Harvard Univ., Cambridge, Mass.). Phys. Rev., 136: A62-8(Oct. 5, 1964).

The rotational magnetic moments of the diatomic alkalies were measured by the molecular-beam magnetic-resonance method. The values obtained for the gyromagnetic ratios g_J (in nm) are: Li_2, 0.10797; Na_2, 0.03892; K_2, 0.02162; Rb_2, 0.00953; Cs_2, 0.00547. The effect of the electric quadrupole interaction on the resonance is investigated, and found to lead to a slight broadening, but, in the limit of high J, to no displacement. An interpretation of the results in terms of the irrotational-flow model used by Espe for hydrogen is given. (auth)

40148 DOUBLE EXCITATION OF HELIUM BY ELECTRON IMPACT. Philip M. Becker and John S. Dahler (Univ. of Minnesota, Minneapolis). Phys. Rev., 136: A73-86(Oct. 5, 1964).

The theory and calculation of cross sections for the electron-impact excitation of doubly excited states in helium which are stable to autoionization are investigated. The cross sections are found to exhibit sharp peaks just above the threshold energies for excitation and to decrease rapidly with further increase of energy. The maximum value of the Born-Oppenheimer cross section for excitation of the $(2p)^2\ ^3P_g$ state is about $6 \times 10^{-4}\ (a_0)^2$ and occurs at approximately 11 ev above threshold. The cross sections for excitation of the $2p3p\ ^1P_g$, $2p3d\ ^3D_u$, and $2p3d\ ^1D_u$ states are all less than 35 b. The cross section for the $(2p)^2\ ^3P_g$ state was calculated according to the Born-Oppenheimer, distorted-wave, and two-state strong-coupling approximations. In all of these cases the maximum amplitude of the scattered beam occurs at right angles to the direction of the incident electrons. The cross sections of the potential-and-exchange-distortion method and of the complete two-state strong-coupling approximation are virtually identical. The Born-Oppenheimer approximation produces remarkably similar results. Rigorous upper bounds to the energies of the $2p3p\ ^1P_g$, $2p3d\ ^3D_u$, and $2p3d\ ^1D_u$ states of helium are reported. Finally, the cross sections are calculated in Born-Oppenheimer approximation for electron-impact excitation of the $(1s)^2(2p)^2\ ^3P_g$ and $(1s)^2 2p3p\ ^3P_g$ states of beryllium. The peak values of these cross sections are $12(a_0)^2$ and $2(a_0)^2$, respectively. (auth)

40149 KINETIC THEORY OF DISSIPATION PHENOMENA IN GAS MIXTURES; APPLICATION TO THE CALCULATION OF DISSIPATION COEFFICIENTS BY A SIMPLIFIED METHOD. J. P. Guiraud (ONERA, Chatillon sous Bagneux, France). Proc. Intern. Symp. Rarefied Gas Dyn., 3rd, Paris, 1962, 1: 226-51(1963). (In French)

A simplified macroscopic theory is presented for calculating the transport coefficients of mixtures of gases. (D.C.W.)

40150 APPLICATION OF A CHARACTERISTIC VALUE METHOD TO THE BOLTZMANN EQUATION OF A WEAKLY IONIZED GAS. J. Naze (Faculte des Sciences, Lille). Proc. Intern. Symp. Rarefied Gas Dyn., 3rd, Paris, 1962, 1: 252-9(1963). (In French)

The properties of the linear (charged particle-molecule) collision operators appearing in the Boltzmann equations for a weakly ionized gas are studied under some general hypotheses concerning the law of interaction. The proper values and functions of the collision operator are obtained for the case of an induced-dipole law. The results are used to calculate the electric conductivities and temperatures of the charged particles. (tr-auth)

40151 SURFACE EROSION IN SPACE. Daniel McKeown (General Dynamics/Astronautics, San Diego, Calif.). Proc. Intern. Symp. Rarefied Gas Dyn., 3rd, Paris, 1962, 1: 315-26(1963).

Measurements of the erosion of gold surfaces were made on Discoverers 26 and 32. The erosion rate was found to be only 0.2 ± 0.1 Å/day and was attributed to sputtering by molecules of the upper atmosphere. The sputtering yield was determined to be less than 5×10^{-6} atom/molecule. The maximum values of sputtering rates varied from 10^{10} atoms/cm^2/sec at 200 km down to 10^7 atoms/cm^2/sec at 800 km. Gold has one of the largest yields of any element, and it is concluded that the erosion of other surfaces in space would be correspondingly low. (auth)

40152 THE SURFACE RE-EMISSION LAW IN FREE MOLECULE FLOW. Silvio Nocilla (Politecnico, Turin). Proc. Intern. Symp. Rarefied Gas Dyn., 3rd, Paris, 1962, 1: 327-46(1963).

A study of validity of the previously introduced re-emission model in the light of more recent experimental results on molecular beams is presented. According to this model, the re-emitted molecules behave as a gas in Maxwellian equilibrium, subject to thermal agitation and moreover to a translation motion. The space distribution law is established for the molecules re-emitted from an elementary rectangular surface and from an infinite strip of elementary width. The theoretical results obtained are then compared with Hurlbut's experimental results obtained with nitrogen molecular beams impinging on lithium fluoride crystals. The comparison enables an estimate to be made of the values of the two fundamental parameters (s_r and θ_r) referred to the re-emitted gas. The theoretical formulas allow one also to specify in what manner a free-molecule flow may be interpreted as a superposition of an infinite number of pencils of elementary molecular beams. (auth)

40153 EXPERIMENTS ON CHARGE AND MOMENTUM EXCHANGE BETWEEN IONS AND MOLECULES IN THE DEVELOPMENT OF HIGH-SPEED MOLECULAR BEAMS. F. M. Devienne, B. Crave, J. Souquet, and R. Clapier (Laboratoire Méditerranéen de Recherches Thermodynamiques, Nice). Proc. Intern. Symp. Rarefied Gas Dyn., 3rd, Paris, 1962, 1: 362-86(1963).

Modifications made to the molecular gun apparatus, involving principally the ion source and the replacement of the electromagnetic deflection system by an electrostatic one, are discussed. Methods that were used for determining the velocity of the molecules are described. The method used allows a rapid determination of the velocity spectrum of the beam. The different methods that were used to determine the intensity of the fast molecular beam, including the use of various detectors, the efficiencies of which were measured, are summarized. In the most recent measurements an aluminum detector whose efficiency was found to be about 10% for energies ranging between 500 and 1500 ev was used. Charge exchange processes were studied and were found to depend on a certain number of parameters. The influence of the density of the low-speed molecular beam, the influence of the charge of the ions, and that of their energy were established. From the efficiencies found, the charge exchange cross section for A^+ in A were calculated. The measurements showed that this cross section was close to 63×10^{-16} cm^2 at 1000 ev, and that it was less for 1500 ev and more for 500 ev. The molecular gun allows one to obtain a well-defined molecular beam having an intensity between 10^{14} and 5×10^{14} molecules/s, with energies ranging between 500 and 1500 ev. The dispersion

of the beam is relatively weak. It depends on experimental conditions, but the beam generally has a constant density in a cross section 2 cm in diameter. (auth)

40154 THE USE OF REVOLVING DISKS IN THE STUDY OF INTERACTION BETWEEN MOLECULES AND A SURFACE. F. Marcel Devienne and G. M. Forestier (Laboratoire Méditerranéen de Recherches Thermodynamiques, Nice). Proc. Intern. Symp. Rarefied Gas Dyn., 3rd, Paris, 1962, 1: 387-413(1963).

To supplement and complete the program of research in rarefied gas dynamics started with a rotating arm apparatus, a new technique for gas-surface interaction measurement was initiated. This involves the use of a high speed rotating disk onto which a molecular beam is allowed to impinge, the reflected molecules being detected with two or more ionization gages. Experiments were performed on the dispersion characteristics of incident beams of argon, helium, nitrogen, carbon dioxide, and xenon, most of the results being expressed in terms of the difference in reflected molecule pressure as observed by the gages, due to rotation of the disk. In addition, theoretical calculations on the polar distribution of reflected molecules were made and were found to agree qualitatively with the experimental results. These preliminary investigations are being extended into a wider and more refined program of study. (auth)

40155 INVESTIGATION OF THE SCATTERING OF GAS MOLECULES ON VARIOUS SURFACES. W. Jawtusch (Forschungsinstitut für Physik der Strahlantriebe e.V., Stuttgart). Proc. Intern. Symp. Rarefied Gas Dyn., 3rd, Paris, 1962, 1: 414-29(1963).

Reflections of molecular beams of air, N_2, and Ar were measured on various synthetic coatings, nickel sheet, and glass. A smooth silver layer was used for a reference surface. It was possible to measure the scattering distribution as a function of the incident angle on the sample surface and on the reference surface. The incomplete momentum transfer of gas particles colliding with the surface results in a decrease of frictional resistance, and must manifest itself in an increased forward scattering. Such a forward scattering was actually observed on the synthetic coatings. It is of interest that the synthetic coatings examined showed a decreased frictional resistance when tested in wind tunnels. The marked increase of forward scattering at small angles of incidence with smooth surfaces is striking. An estimate analogous to that of Hurlbut, who measured the scattering of N_2 molecules on a glass surface, shows a considerably higher scattering in the forward direction (equivalent to a higher proportion of specularly reflected particles). The test results seem to indicate that it is not just the surface smoothness that is responsible for specular reflection (and thus for the decrease in friction), but that other causes are probably responsible to an even larger extent. (auth)

40156 STUDIES OF NORMAL MOMENTUM TRANSFER BY MOLECULAR BEAM TECHNIQUES. R. E. Stickney and F. C. Hurlbut (Univ. of California, Berkeley). Proc. Intern. Symp. Rarefied Gas Dyn., 3rd, Paris, 1962, 1: 454-69(1963).

The transfer of normal momentum between gases and metallic surfaces was studied under conditions of free molecular flow by means of a torsion balance and molecular beam apparatus. Thermal beams of helium, hydrogen, neon, nitrogen, carbon dioxide, and argon were directed against surfaces of tungsten, platinum blackened tungsten, platinum, and aluminum with surface temperatures in the range 25 to 550°C. The efficiency of momentum transfer is found to increase with the molecular weight of the test gas and the roughness of the test surface, but is relatively independent of the substrate material, under present conditions. The momentum transfer rates for helium and hydrogen are significantly less than those measured for the heavier gases, surface temperatures being equal. The momentum accommodation of the test gases appears to be incomplete except, possibly, for argon and carbon dioxide. The results are used to estimate the value of a modified coefficient of momentum transfer for each gas-surface combination. (auth)

40157 ENERGY TRANSFER DURING ATOM RECOMBINATION ON SOLID SURFACES. Henry Wise and Bernard J. Wood (Stanford Research Inst., Menlo Park, Calif.). Proc. Intern. Symp. Rarefied Gas Dyn., 3rd, Paris, 1962, 1: 470-7(1963).

The potential energy of a gaseous atom having an unpaired electron may be released upon surface catalysis during which a diatomic molecule is formed by heterogeneous atom recombination. The chemical kinetics of this reaction was studied experimentally, and quantitative measurements were made of the efficiencies of various solids for atom recombination. In addition, the coefficients of energy accommodation associated with the heterogeneous reaction were obtained. Solids which catalyze atom recombination most strongly appear to be poorest in energy accommodation. As a result, the molecule formed is not in temperature equilibrium with the surface but departs into the gas phase with an excess of energy. The coupling between vibrational and translational energy is known to be weak so that many collisions may be necessary for relaxation. These processes may have an important influence on the forces exerted on a body, particularly in environments in which free-molecule flow obtains. (auth)

40158 INFLUENCE OF SHOCK WAVES ON THE GENERATION OF HIGH-INTENSITY MOLECULAR BEAMS BY NOZZLES. K. Bier and O. Hagena (Technische Hochschule, Karlsruhe, Ger.). Proc. Intern. Symp. Rarefied Gas Dyn., 3rd, Paris, 1962, 1: 478-96(1963).

In generating high-intensity molecular beams by nozzles shock waves should be avoided as far as possible since they cause broadening of the velocity distribution and reduction in the particle flow density of the molecular beam. The conditions for occurrence and the effect of shock waves are investigated by measuring the velocity distribution and intensity of CO_2 beams generated by expansion from a convergent nozzle. It is shown that, under certain conditions, a strong shock wave connected with the shock system of the freely expanding jet occurs. This shock wave, which is detached from the first diaphragm used for screening-out the core of the supersonic flow, reduces the beam intensity in beams of single molecules by about one order of magnitude, in beams of condensed particles by almost two orders of magnitude. Even if this strong shock wave is avoided by choosing proper test conditions in the nozzle source, weaker shock waves arising from the edge of the first diaphragm may occur downstream from this diaphragm. Possibilities of avoiding these weaker shock waves are discussed. (auth)

40159 MOLECULAR BEAMS FROM NOZZLE SOURCES. John B. Fenn and Jacques Deckers (Princeton Univ., N. J.). Proc. Intern. Symp. Rarefied Gas Dyn., 3rd, Paris, 1962, 1: 497-515(1963).

A high-intensity molecular beam apparatus was built and operated. It is based on the suggestion of Kantrowitz and Grey that supersonic flow into the first defining orifice should result in much higher intensities and much nar-

rower velocity distributions than can be obtained by classical effusive sources. Performance of this system is reviewed and compared with theory. An attempt is made to explain the marked deviations from theory which occur under some conditions. A model is developed which is at least consistent with observed performance and which should be useful in the design and use of such systems. Possible applications of nozzle beams are outlined. Some interesting implications of small scale low density flow are noted. (auth)

40160 CHARACTERISTICS OF AERODYNAMIC MOLECULAR BEAMS. John E. Scott, Jr., and James E. Drewry (Univ. of Virginia, Charlottesville). Proc. Intern. Symp. Rarefied Gas Dyn., 3rd, Paris, 1962, 1: 516-38(1963).

The essential features of molecular beams formed in nozzle sources are compared to those from standard sources. Production of ordered motion results in increased beam intensity and improved distribution of molecular velocities in the collimated beam. Experimental results demonstrate the variation of beam flux with distance between the nozzle throat and the entrance to the first beam aperture (skimmer). Beam intensities exceeding 10^{17} molecules/sec/cm^2 were observed with nitrogen. A differential ion gage beam detector is described, and calibration experiments demonstrate its precision and reliability. It is concluded that the use of aerodynamic molecular beams together with the differential ion gage detector enable the performance of scattering experiments not heretofore realizable. (auth)

40161 INELASTIC COLLISION OF IONS IN GASES. S. B. Karmahapatro (Saha Inst. of Nuclear Physics, Calcutta). Proc. Natl. Acad. Sci. India, Sect. A, 33: 563-72 (1963).

The cross sections for charge exchange by ions in gases were measured as a function of velocity. A qualitative explanation of the curves was obtained with the adiabatic hypothesis. Cross sections for ions of different energies were also calculated by a quantum mechanical theory. (D.C.W.)

40162 THE ELASTIC SCATTERING OF SLOW ELECTRONS BY CARBON. V. P. Myerscough and M. R. C. McDowell (London Univ.). Proc. Phys. Soc. (London), 84: 231-8(Aug. 1964).

Phase shifts, partial cross sections, and total cross section for the elastic scattering of slow electrons by carbon are calculated in the static central field exchange approximation. The scattering length and the zero energy cross section are measured. A resonance in the p-wave scattering is predicted at 0.605 ryd, in the neighborhood of the first excited state of carbon, and a Ramsauer minimum at 0.71 ryd. (auth)

40163 LOWER BOUNDS FOR THE ENERGY OF H_2^+. B. P. Johnson and C. A. Coulson (Oxford Univ.). Proc. Phys. Soc. (London), 84: 263-8(Aug. 1964).

A method for calculating lower bounds for the energy in a wave-mechanical problem is applied to the molecule ion H_2^+. Using a basic set of up to six atomic orbitals on each nucleus, lower bounds are calculated for both σ_g and σ_u states. The convergence of the method, as additional functions are added to the basic set, appears to be too slow for effective practical purposes. (auth)

40164 ELECTROMAGNETIC RADIATION GENERATED BY A CURRENT SOURCE IN AN ANISOTROPIC MEDIUM. J. F. McKenzie (Cambridge Univ., Eng.). Proc. Phys. Soc. (London), 84: 269-79(Aug. 1964).

The expressions for the electromagnetic field generated by an arbitrary current source in an anisotropic medium are calculated by Fourier analysis. The radiation emitted by a charged particle moving in a helical orbit of uniform pitch in a magnetoionic medium is evaluated. (auth)

40165 SHIELDING FOR THE CRYSTALLINE ELECTRIC FIELD AND FOR THE NUCLEAR QUADRUPOLE MOMENTS IN RARE-EARTH IONS. M. N. Ghatikar, A. K. Raychaudhuri, and D. K. Ray (Saha Inst. of Nuclear Physics, Calcutta). Proc. Phys. Soc. (London), 84: 297-307 (Aug. 1964).

In order to determine the nature of the shielding for the crystalline electric field and the nuclear quadrupole moments in rare earth ions, analytic expressions have been derived for these parameters using hydrogenic orbitals with appropriate screening constants. The dependence of the shielding parameters on the atomic screening constants is indicated. The shielding of the crystalline field parameters A_l^m corresponding to different values of l is shown to fall off as l increases, and for most of the orbitals the sign of the shielding parameter is such that it acts as a shielding rather than an anti-shielding. Generalized expressions for the shielding of nuclear moment of any order of magnitude have also been derived, which show that the radial contributions increase with the increase in the value of l for any particular orbital. There is agreement with the values of γ_∞ of Sternheimer for the Pr^{3+} ion if Z_{eff} for the outer 5p and 4p orbitals is taken to be about 3 and 11 respectively. The inadequacy of the shielding effect in explaining some of the experimentally observed crystalline field parameters has been pointed out. (auth)

40166 ASYMPTOTIC FORM OF THE IMPULSE APPROXIMATION ELECTRON CAPTURE CROSS SECTION: EXACT RESONANCE. [PART] II. J. Coleman and M. R. C. McDowell (Royal Holloway Coll., Surrey, Eng.). Proc. Phys. Soc. (London), 84: 334-6(Aug. 1964).

The full form of the impulse approximation is used to calculate the asymptotic form of the cross section for the exact resonance electron capture process $H^+ + H(1s) \rightarrow H(1s) + H^+$. The result is identical with that obtained using the first Born approximation. (auth)

40167 THE CALCULATION OF THE ELECTRON SCATTERING LENGTHS ON ATOMS. A. D. Gurchumeliya (Polytechnical Inst., Tbilisi, USSR). Soobshch. Akad. Nauk Gruz. SSR, 32: 549-54(1963). (In Russian)

The Schrodinger equation for the l-th partial wave was solved using the integration method of Numerov. The scattering lengths for C, N, O, Ar, and Zn were calculated, using the Gashpar, Hartree, and Hartree-Fock-Slater potentials. The elastic scattering cross sections for C, N, O, Na, Ar, Ge, and Zn were also obtained. (D.C.W.)

40168 CATHODE SPUTTERING UNDER BOMBARDMENT BY CESIUM IONS. S. Ya. Lebedev, Yu. Ya. Stavisskii, and Yu. V. Shut'ko. Zh. Tekhn. Fiz., 34: 1101-4(June 1964). (In Russian)

A study was made of the dependence of the coefficient of cathode sputtering of Ni, Ti, Nb, Pt, C, Mo, Re, W, Ta, and Fe on the energies of bombarding cesium ions (2 to 10 kev) at different temperatures of the investigated materials (700 to 1100°C). (tr-auth)

40169 IONIC BOMBARDMENT THEORY AND APPLICATIONS. International Symposium, Bellevue, December 4 to December 8, 1962. Translation of "Le Bombardement Ionique, Theories et Applications." New York, Gordon and Breach Science Publishers, 1964. 359p. $19.50.

The proceedings, presented in English, were previously abstracted from the original language and appear in NSA,

Vol. 18 as abstracts 28101, 28102, 28103, 28104, 28105, 28106, 28107, 28108, 28109, 28110, 28111, 28112, 28113, 28114, 28115, 28116, 28117, 28118, 28119, 28120, 28121, 28122, 28123, 28124, 28125, and 28126. (M.C.G.)

40170 LINEAR STARK BROADENING BY CHARGED PARTICLES. Akiko Ohno (Uppsala Univ.). 29p. (CONF-452-46)

From American Physical Society, Washington, D. C., Apr. 1964.

A general theory of the linear Stark broadening of a spectral line by surrounding charged particles (both electrons and ions) is presented. The results are applied to the Lyman α line of hydrogen. (T.F.H.)

40171 CORRECTION TO THE RYDBERG CONSTANT FOR FINITE NUCLEAR MASS. Moody L. Coffman (Oklahoma City Univ.). 8p. (CONF-481-80)

From American Physical Society Annual Meeting, New York, Jan. 1964.

If the problem of the hydrogen-like atom is done with the assumption that the nucleus is at rest, the resulting energy levels are proportional to the Rydberg constant for infinite mass. It is traditional to obtain the Rydberg constant for finite mass of the nucleus by a simple substitution of the reduced mass of the system for the electron mass in the expression for the Rydberg constant for infinite nuclear mass. Realization that such a substitution (which is drawn from classical mechanics) does not give a correct transformation to the center-of-mass coordinate system in the case of charged particles, leads to significant corrections for the Rydberg constants of finite nuclear masses. The corrections are drawn from classical, nonrelativistic physics. Also, an interesting conjecture about the energy levels of hydrogen-like atoms, under the assumptions of Bohr theory and classical physics, was obtained. (auth)

40172 THE SIGN OF THE ELECTRIC FIELD GRADIENT IN IRON SALTS FROM A RELATION BETWEEN THE ISOMERIC SHIFT AND THE QUADRUPOLE INTERACTION. P. H. Remy and H. Pollak (Lovanium Univ., Leopoldville, Congo). 31p. (CONF-303-18)

From 3rd International Conference on the Mössbauer Effect, Ithaca, N. Y., Sept. 1963.

By analyzing experimental measurements on the isomeric shift and on the quadrupole interaction in iron salts, for each charge state, a linear relation is found between these quantities. The slope is independent of the valency of the iron ion: this result is interpreted by assuming that the bound iron electronic configurations are $3d^x 4s^{y+1}$ and $3d^x 4s^y$ respectively for Fe^{2+} and Fe^{3+}. With the aid of the linear correlations, the sign of the electric field gradient is determined unambiguously in the iron salts for which the experimental measurements of the isomeric shift and the quadrupole splitting are accurate. In the absence of quadrupole interaction, the isomeric shifts, with respect to a 310 stainless steel source, are 1.12 ± 0.03 mm/sec for Fe^{2+} and 0.48 ± 0.03 mm/sec for Fe^{3+}. (auth)

40173 NON-LINEAR INTERACTION COEFFICIENTS FOR ELECTRONS IN NITROGEN AND AIR. A. V. Phelps (Westinghouse Research Labs., Pittsburgh). 24p. (CONF-630-2)

From Conference on Non-Linear Processes in the Ionosphere, Boulder, Colo., Dec. 1963.

An analysis of measured electron transport coefficients for nitrogen and oxygen yielded a consistent set of energy-dependent cross sections for the momentum transfer and inelastic scattering of electrons in these gases. These results are used with the appropriate Boltzmann transport equation to predict the effects of the heating of electrons in nitrogen and air by radio frequency fields. The rapid increase in mean energy with electric field predicted by Altshuler at high frequencies is obtained, but the calculations do not show the predicted hysteresis effect. These procedures have made possible the direct calculation of cross modulation coefficients rather than the usual procedure of first evaluating the change of mean energy produced by an electric field and then calculating the change in propagation constant. (auth)

Cosmic Radiation

Refer also to abstracts 40333, 40430, and 40745.

40174 (AFCRL-64-395) SPECTRAL VARIATIONS DURING COSMIC-RAY STORMS. Technical Note No. 4. B. O. Groenkvist (Uppsala Univ. Inst. of Physics). Mar. 20, 1964. Contract AF61(052)-614. 21p. (AD-600367)

Three cosmic ray storms during the IGY, which differ as to the type, were treated for a study of changes in the effective integral rigidity spectrum. The time dependence of the exponent gamma of the spectrum is illustrated for the rigidity region 11 to 18 GV with a time resolution of two hours. An analytical expression is given where changes in the effective integral spectrum are transformed into changes in the primary spectrum. The extreme values of these changes vary from one storm to another. An extension of the treatment to lower rigidities is discussed. (auth)

40175 COSMIC IRRADIATION DAMAGE IN METEORITIC GRAPHITE. W. Bollmann (Battelle Memorial Inst., Geneva) and R. E. Maringer. Geochim. Cosmochim. Acta, 28: 1359-60(Aug. 1964).

A possible alternative method for the determination of cosmic-ray exposure ages is reported. Dust from a graphite nodule in the Rifle, Colo., meteorite was examined by electron transmission microscopy. Comparing the observed damage with that caused by fast neutrons showed that the damage is the equivalent of about 5×10^{16} fast neutrons per cm^2. If it is assumed that cosmic rays are the equivalent of fast neutrons, then dividing the 5×10^{16} by an estimate of the omnidirectional cosmic-ray flux (4 particles/cm^2 sec) gives a time that is presumably the cosmic-ray exposure age. In this case, this turns out to be about 4×10^8 years. (P.C.H.)

40176 LATITUDINAL MEASUREMENTS OF COSMIC-RAY INTENSITY IN THE STRATOSPHERE. V. K. Babarykin. Geomagnetizm i Aeronomiya, 4: 458-63(1964).

The intensity of cosmic rays in the stratosphere was measured on board the steamship "Estoniya," which sailed from Leningrad to the shores of Antarctica. At the same time, observations with identical instruments were carried out at Murmansk, Moscow, and Alma Ata. Data obtained at these places and in the equatorial belt in December 1962 are represented graphically. The curves are similar. The sounding flights reached heights of 27 to 30 km, from which the intensity of cosmic rays could be determined at low pressures and at various geomagnetic latitudes. Attempts to determine the intensity of cosmic rays at the upper boundary of the atmosphere by extrapolation yielded exaggerated results. Data on the latitudinal distribution of cosmic-ray intensity are used for computing the coupling coefficients. Numerical values of the coupling coefficients for all stations are tabulated. (ATD Press, Vol. 3: No. 41, Aug. 1964)

40177 LOCAL TIME DEPENDENCE OF NON-STÖRMER CUTOFF FOR 1.5 Mev PROTONS IN QUIET GEOMAGNETIC FIELD. Edward C. Stone (Univ. of Chicago). J. Geophys. Res., 69: 3577-82(Sept. 1, 1964).

Two solid-state detector telescopes, vertically and horizontally oriented, were launched into a polar orbit during a time of low geomagnetic activity. A small flux of 1.5-Mev protons, interacting with the geomagnetic field as individual particles, was observed at all latitudes above a characteristic cutoff latitude. The observed vertical cutoff was 65° (equivalent dipole latitude) on the night side and 67° on the day side, as compared with a theoretical Störmer cutoff of 76°. The local time dependence was also apparent in the cutoff transition width characterized by the difference in the latitude at which the flux is first detectable and the latitude at which the maximum (plateau) flux is first observed. On the night side, the transition width was about 1°; on the day side it was about 3° and variable. The horizontal cutoff latitudes were similar. Essentially identical results were obtained over north and south poles. These results are not adequately predicted by currently postulated cutoff theories and should be considered in the calculation of proton fluxes associated with polar-cap absorption. (auth)

40178 SOLAR-FLARE ENHANCEMENTS OF IONIZATION AT F-REGION HEIGHTS. R. E. Winkelman and R. B. Dyce (Stanford Research Inst., Menlo Park, Calif.). J. Geophys. Res., 69: 3625-32(Sept. 1, 1964).

Vertical phase path measurements of pulsed radio waves reflected from the ionosphere at 5953 and 6110 kc, and an oblique Loran A 1850-kc path were examined during known solar flares. A synthesis of a solar-induced ionization component leads to the conclusion that deposition is predominantly in the F region. (auth)

40179 ISOTOPIC COMPOSITION AND ENERGY SPECTRUM OF LOW-ENERGY HELIUM NUCLEI IN PRIMARY COSMIC RADIATION. C. Dahanayake, M. F. Kaplon, and P. J. Lavakare (Univ. of Rochester, N. Y.). J. Geophys. Res., 69: 3681-99(Sept. 1, 1964). (UR-875-31)

The isotopic composition and energy spectrum of low-energy helium nuclei have been investigated, using a nuclear emulsion stack flown from Fort Churchill, Canada on August 4, 1962. The proportion of ^{3}He nuclei at the top of the atmosphere was determined to be 18 ± 5% within the kinetic energy interval of 160 to 370 Mev/nucleon and 24 ± 8% within the rigidity interval 1.1 to 1.4 bv/c. The differential energy spectrum in the above energy interval was found to have a maximum around 275 to 300 Mev/nucleon. Assuming that there is no ^{3}He at the cosmic-ray sources, and that the observed abundance reflects the interactions of the primary radiation in its passage through interstellar matter, the low-energy primary radiation is concluded to have traveled a total of 6 ± 2 g/cm^2 in this medium. This result is found to be consistent with the values obtained from the low-energy lithium, beryllium, and boron experiment. The implications of these results are examined on the basis of different models used for the propagation of cosmic radiation through interstellar matter. (auth)

40180 ON THE RELATIVE CHARACTERISTICS OF PROTON AND HELIUM SPECTRUMS IN PRIMARY COSMIC RADIATION. M. V. K. Apparao and S. Ramadurai (Tata Inst. of Fundamental Research, Bombay). J. Geophys. Res., 69: 3729-32(Sept. 1, 1964).

For the galactic differential spectra of cosmic protons and alpha particles, three different forms are tried: alpha and proton spectra that are similar functions of energy; spectra that are similar functions of rigidity; and spectra that take into account ionization and interaction losses during the traversal of interstellar space by the particles. It is concluded that the relative characteristics of the cosmic alpha particle and proton spectra, as deduced from experiment, can be understood in terms of solar modulation as given by solar-wind theory, starting with the above trial spectra. (T.F.H.)

40181 STRONG INTERACTIONS THEORY AND COSMIC RADIATION. E. L. Feinberg and D. S. Chernavskii (Lebedev Inst. of Physics, Moscow). Nukleonika, 9: 75-86 (1964). (In Russian)

The Regge-pole method, the single-meson approximation, and the multiperipheral model for strong interactions are surveyed, coordinating them with experimental facts. Questions on correlations of elastic and quasi-elastic collisions are considered in the framework of these methods. Hydrodynamic theory and the peripheral hydrodynamic model are discussed. Experimentally verified predictions of theory are surveyed, and concrete problems which could be experimentally tested are proposed. (M.J.T.)

40182 DISTRIBUTION IN HELIOGRAPHIC LONGITUDE OF FLARES WHICH PRODUCE ENERGETIC SOLAR PARTICLES. Donald E. Guss (Goddard Space Flight Center, Greenbelt, Md.). Phys. Rev. Letters, 13: 363-4(Sept. 21, 1964).

A set of 56 solar flares that occurred between Jan. 16, 1955 and Oct. 23, 1962 is grouped into 10° heliographic longitude increments. The flares fall into longitude bands, with one band (80 to 90° with an arbitrary zero) contributing about 75% of the integrated particle intensity with energy greater than 30 Mev and about 90% of that with kinetic energy greater than 100 Mev detected at the earth during the solar cycle containing the 56 events. Of ten solar events that produced neutron-monitor increases, seven are in this 80 to 90° band. The results for the 80 to 90° band indicate the presence of a solar active center that persisted for more than 73 solar rotations. (T.F.H.)

40183 FLUX OF PRIMARY COSMIC-RAY ELECTRONS OF RIGIDITY ABOVE 4.5 BV. B. Agrinier (CEN, Saclay, France), Y. Koechlin, B. Parlier, G. Boella, G. Degli Antoni, C. Dilworth, L. Scarsi, and G. Sironi. Phys. Rev. Letters, 13: 377-80(Sept. 21, 1964).

A cylindrical spark chamber is flown at a depth in the atmosphere of 4.3 to 4.9 g/cm^2 (36 to 37 km altitude). Within the experimental limits of accuracy, the primary cosmic-electron flux is found to be 6.6 electrons/m^2/sec/sr. The measurements are made during a solar activity minimum, at latitude corresponding to a cutoff rigidity of 4.5 bv. The spectral properties of the detected electrons are discussed. (T.F.H.)

40184 ANGULAR DISTRIBUTION OF THE INTENSITY OF CHERENKOV RADIATION FROM BROAD COSMIC-RAY AIR SHOWERS. V. I. Zatsepin (Lebedev Inst. of Physics, Moscow). Zh. Eksperim. i Teor. Fiz., 47: 689-96(Aug. 1964). (In Russian)

The angular distribution of the intensity of Cherenkov light produced in the atmosphere by broad cosmic showers is calculated. The calculations are performed for vertically incident showers at sea level and at an altitude of 3860 meters. A photograph of the shape of a light flash on the firmament is apparently in good agreement with the calculations. (auth)

40185 INTERNATIONAL CONFERENCE ON COSMIC RAYS, JAIPUR, DECEMBER 2-14, 1963, PROCEEDINGS. VOLUME 5. HIGH ENERGY INTERACTIONS. Under the Auspices of The International Union of Pure and Applied

Physics and The Department of Atomic Energy, Government of India. R. R. Daniel, P. J. Lavakare, M. G. K. Menon, S. Naranan, N. W. Nerurkar, Yash Pal, and B. V. Sreekantan, eds. Bombay, The Commercial Printing Press Limited, 1964. 610p. Available from Tata Inst. of Fundamental Research, Bombay.

Separate abstracts were prepared for sixty of the sixty-seven papers included. Seven papers were previously abstracted for NSA: see 18: 2048, 9119, 22368, 30438, 30515, 34632, 34964. (A.G.W.)

For abstracts of individual papers see: 38992, 39692, 39693, 39694, 39695, 39696, 39697, 40186, 40187, 40188, 40189, 40190, 40191, 40192, 40193, 40194, 40195, 40196, 40197, 40198, 40199, 40200, 40201, 40202, 40203, 40204, 40205, 40206, 40207, 40208, 40209, 40210, 40357, 40358, 40359, 40360, 40361, 40362, 40363, 40364, 40365, 40366, 40367, 40368, 40369, 40370, 40371, 40372, 40373, 40614, 40615, 40616, 40617, 40618, 40619, 40620, 40621, 40622, 40623, and 40624.

40186 ENERGY DISTRIBUTION OF SECONDARIES OF PROTON STARS IN THE TEV ENERGY RANGE. U. Haber-Schaim, B. Reuter, and G. Yekutieli (Weizmann Inst. of Science, Rehoboth, Israel). p.14-16 of "International Conference on Cosmic Rays. Vol. 5." Bombay, Tata Inst. of Fundamental Research, 1964.

The ICEF data were used to analyze the energy distribution of secondary particles emitted in the forward cone of proton interactions with energy between 1 and 50 Tev. Only secondary particles that make further interaction in the emulsion were considered. The fraction f = (secondary energy)/(primary energy) for each secondary was evaluated. Both energies were estimated by the Castagnoli method. A table shows the distribution of the fractions f for all secondaries in the energy range and for a selected group biased against tertiaries. (A.G.W.)

40187 THE INTERACTION MEAN-FREE-PATH OF NUCLEONS AND ALPHA PARTICLES OF HIGH ENERGIES IN NUCLEAR EMULSION. R. R. Daniel, N. Durgaprasad, P. K. Malhotra, and B. Vijayalakshmi (Tata Inst. of Fundamental Research, Bombay). p.17-18 of "International Conference on Cosmic Rays. Vol. 5." Bombay, Tata Inst. of Fundamental Research, 1964.

Data from the ICEF 80-liter pure emulsion stack were used in an attempt to make realistic estimates of the inelastic interaction mean-free-paths of protons and α particles in emulsions. After correcting for biases involved, the best estimate obtained for the interaction mean free path of nucleons at a median energy of ~7 Tev was 27^{+37}_{-10} cm (90% confidence level). For α particles the best estimate obtained was 18^{+20}_{-4} cm (90% confidence level). These values are compared with results of investigations at machine energies. (A.G.W.)

40188 SOME RESULTS FROM THE SYDNEY 20 LITRE EMULSION STACK. C. F. Gauld, A. J. Gray, C. B. A. McCusker, L. S. Peak, and R. L. S. Woolcott (Univ. of Sydney). p.31-4 of "International Conference on Cosmic Rays. Vol. 5." Bombay, Tata Inst. of Fundamental Research, 1964.

A 20-liter emulsion stack exposed for $6\frac{1}{2}$ hr at an altitude of 116,000 ft was scanned for electromagnetic cascades, and 54 of these were found to be produced by single charged primary particles with a median Castagnoli energy of 2800 Bev. The fact that the transverse momentum of secondary particles is constant with energy was used to find the energy of the interacting secondary particles without recourse to the Castagnoli method. A table shows the variation of n_s and N_h with energy. Results agree with those of machine experiments up to 25 Bev. No elastic scatters of primary protons but five examples of direct electron pair production by protons were found. (A.G.W.)

40189 THE MULTIPLICITY OF MESON PRODUCTION AT 3000 Gev AND THE COSMIC RAY PROTON ENERGY SPECTRUM. C. B. A. McCusker and L. S. Peak (Univ. of Sydney). p.35-9 of "International Conference on Cosmic Rays. Vol. 5." Bombay, Tata Inst. of Fundamental Research, 1964.

Two problems in determining the nature of high-energy nucleon-nucleon interactions in emulsions are discussed: (1) estimation of the energy of the interaction and (2) simplification of the complex collisions occurring by interpreting them in terms of nucleon-nucleon interactions. It is concluded that the median Castagnoli energy estimate is reliable for a sample over a wide energy range. The average charged multiplicity for nucleon-nucleon interactions at 2800 Bev is found to be 10.8 ± 0.8. It appears to increase logarithmically with energy. (A.G.W.)

40190 INVESTIGATION OF NUCLEAR INTERACTIONS AT ENERGIES 10^{13} ev BY THE METHOD OF CONTROLLED NUCLEAR PHOTOEMULSIONS. Kh. P. Babayan, S. I. Brikker, N. L. Grigorov, A. V. Podgurskaya, A. I. Saveleva, and V. Ya. Shestoperov (Moscow State Univ and Inst. of Physics, Erevan). p.51-7 of "International Conference on Cosmic Rays. Vol. 5." Bombay, Tata Inst. of Fundamental Research, 1964.

The 10-m^2 installation used in this investigation consisted of 5 trays of long cylindrical ionization chambers. Above the fourth tray were three layers of Pb filters with nuclear photoplates between them. A graphite filter was placed over the Pb filters, and above it the fifth tray covered with a 3-cm layer of Pb. Six showers were found, and a table shows the following for each: the fraction of energy transferred to π^0 mesons, the number of π^0 mesons, and the energy of the most energetic π^0 meson. The average value of the transverse momentum of γ rays for the showers registered was found to be $(1.71 \pm 0.11) \times 10^8$ ev/c. The average π^0-meson transverse momentum was $(3.2 \pm 0.2) \times 10^8$ ev/c. (A.G.W.)

40191 INVESTIGATION OF THE JETS ABOVE 10^{11} ev. L. A. Sanko, Zh. S. Takibaev, and P. A. Usik. p.58-63 of "International Conference on Cosmic Rays. Vol. 5." Bombay, Tata Inst. of Fundamental Research, 1964.

Characteristics of 90 jets with $N_h \leq 2$ and 98 jets with $N_h \geq 8$ generated in photoemulsions by singly charged cosmic particles are analyzed. The main numerical results are summarized in a table. The results are compared with predictions of the fireball model, and limitations of the fireball model are listed. A new model is proposed, which agrees better with this experiment. (A.G.W.)

40192 HIGH ENERGY COSMIC RAY RESEARCH AT BRISTOL. P. H. Fowler (Wills Physics Lab., Bristol, Eng.). p.182-209 of "International Conference on Cosmic Rays. Vol. 5." Bombay, Tata Inst. of Fundamental Research, 1964.

Research in progress at Bristol can be divided into two parts: (1) an attempt to detect an omnidirectional primary γ flux for energies >400 Bev and (2) the study of high-energy nuclear interactions of cosmic rays and the consequent γ-ray production. In the first part, a stack of tungsten and emulsion sheets was flown at 7 g/cm^2 for 10 hr from S. Italy. Only 17 γ rays were detected, $E_\gamma >$

500 Bev, and their angular distribution and intensity was consistent with an absence of primary γ rays, giving a lower limit to any omnidirectional primary flux of 5×10^{-6} quanta/cm^2 ster., that is $\sim 10^{-3}$ of the primary flux. In the second part, a stack of tungsten and emulsion sheets was flown at 22 g/cm^2 for 28 hr from Hyderabad, India. Results are shown in 17 figures and 4 plates. They are summarized by saying that the distribution in total energy of the pions approximates an exponential one with a mean value equal to 4 Bev. The high-energy γ rays are not numerous and do not appear to form any separated group; so the pionization process appears to be capable of accounting for all the data. (A.G.W.)

40193 ASYMMETRY IN HIGH ENERGY NUCLEAR JETS. J. Gierula and M. Miesowicz (Inst. of Nuclear Research, Krakow). p.213-17 of "International Conference on Cosmic Rays. Vol. 5." Bombay, Tata Inst. of Fundamental Research, 1964.

Among 71 primary high-energy jets found in ICEF collaboration and fulfilling the conditions $N_h \leq 5$, $n_s \leq 20$, and $\gamma_c > 23$, 10 events were found with $\gamma_c > 230$. Their individual angular distributions expressed in log tan θ coordinates are shown in a figure. It is suggested that this extremely high γ_c may be used as a criterion of an asymmetric emission of secondary particles in the center-of-mass system. Arguments for this based on characteristics of the events are as follows: (1) inconsistency of E_c values with the primary energy spectrum; (2) inconsistency of E_c values with the "most likely energy;" (3) isotropy observed for composite angular distribution of particles emitted in narrow cones of jets with extremely high γ_c values; (4) correlation of very high E_c with small multiplicity. (A.G.W.)

40194 ANALYSIS OF ANGULAR DISTRIBUTIONS OF SECONDARY PARTICLES IN NUCLEAR INTERACTIONS OF HIGH ENERGY IN PHOTOGRAPHIC EMULSIONS. G. B. Zhdanov (Lebedev Inst. of Physics, Moscow). p.218-26 of "International Conference on Cosmic Rays. Vol. 5." Bombay, Tata Inst. of Fundamental Research, 1964.

The problem of classification of interactions in a photographic emulsion from the viewpoint of inelasticity coefficients of K_M associated with an initially motionless participant of the interaction is discussed. Data from several sources are used in the analysis. Figures show the following: (1) distributions by multiplicity for primary and secondary interactions under different criteria of selection of stars by the value of N_h; (2) distribution of the values of E_{cast}, E_{ch}, and E_γ for all the primary interactions selected by the values of n_s; (3) distribution of the values of K_M in a mirror system for primary interactions of multiplicity $N_s \leq 22$ at $N_h \leq 8$; and (4) angular distribution of particles averaged by separate groups of most interesting events. (A.G.W.)

40195 THE PRODUCTION-SPECTRUM OF PARTICLES IN INTERACTIONS ABOVE 1000 Gev. E. Heidbreder and K. Pinkau (Universitat, Kiel). p.227-31 of "International Conference on Cosmic Rays. Vol. 5." Bombay, Tata Inst. of Fundamental Research, 1964.

A stack of 600 μ emulsions was exposed from Feb. 14 to Aug. 20 at an altitude of 2900 m at an average temperature of about 0°C. The scanning was performed by the unaided eye. After finding a cascade, the surrounding area was scanned for other members of a possible family. Three large families have been found. Target diagrams of the families are shown with the integral energy spectra. The combined spectrum of all three families normalized to the total energy content in the cascades has an integral slope of 1.34. The analysis is continuing. (A.G.W.)

40196 THE STUDY OF "YOUNG" AIR SHOWERS AT AN ALTITUDE OF 3200 M ABOVE SEA LEVEL. Kh. P. Babayan, N. L. Grigorov, E. A. Mamidjanian, V. Ya. Shestoperov, and Ch. A. Tretyakova (Moscow State Univ. and Inst. of Physics, Erevan). p.248-52 of "International Conference on Cosmic Rays. Vol. 5." Bombay, Tata Inst. of Fundamental Research, 1964.

A study of "young" air electron-photon showers was carried out at an altitude of 3200 m on Mount Aragadz in Armenia. It may be shown that the 279 showers registered were born at a height no more than 4 cascade units above the arrangement. The fact that the experimental data disagree with calculations for interactions with mean characteristics indicates that the young air showers are produced in interactions essentially different from typical interactions. It was found that the average nucleon energy in the registered young showers does not exceed 0.19 and that the total inelasticity coefficient in interactions in which young air showers are produced is no less than $81 \pm 3\%$. From the fact that the nucleon keeps on the average only some 20% of the energy of the primary, it is concluded that the processes of the decay of isobars and hyperons into a high-energy π^0-meson and a nucleon play no essential role in the generation of young showers. (A.G.W.)

40197 FAST COSMIC RAY NEUTRONS IN THE ATMOSPHERE. Serge A. Korff (New York Univ., New York). p.255-9 of "International Conference on Cosmic Rays. Vol. 5." Bombay, Tata Inst. of Fundamental Research, 1964.

A recoil detector consisting of a liquid scintillator surrounded by a solid phosphor was used to measure the flux of fast neutrons in cosmic radiation. A figure shows the observed counting rate as a function of altitude from about 10,000 to 90,000 ft. No sign of leveling off is seen up to the top altitude reached. The flux of neutrons in the energy interval from 1 to 10 Mev at the altitude where the counting rate is a maximum was found to be 1.9 n/cm^2 sec. Fast and slow neutron measurements are compared briefly and rates of production and disappearance of neutrons are calculated. (A.G.W.)

40198 RATIO OF PIONS TO PROTONS AND RATIO OF NEUTRAL TO CHARGED INTERACTING PARTICLES AT MOUNTAIN ALTITUDE OF 800 gms/cm^2. S. Lal, R. Raghavan, T. N. Rangaswamy, B. V. Sreekantan, and A. Subramanian (Tata Inst. of Fundamental Research, Bombay). p.260-4 of "International Conference on Cosmic Rays. Vol. 5." Bombay, Tata Inst. of Fundamental Research, 1964.

The experimental arrangement used in this study consisted of a multiplate cloud chamber with an air Cherenkov counter above and a total absorption spectrometer below. The cloud chamber was triggered with a selection system that selected only charged interacting particles for part of the run and made no distinction between charged and neutral interacting particles for the rest of the operating period. From 215 events recorded during the first part of the run and 231 recorded in the second part, the following conclusions were drawn: (a) the ratio of pions to protons at mountain altitudes is as high as 0.48 ± 0.11 in the energy region 20-40 Bev; (b) the ratio of neutral to charged particles is 0.66 ± 0.11 in the 20-40 Bev region and 0.40 ± 0.12 at about 60 Bev; (c) the ratio of neutrons to protons in the energy region 20-40 Bev is 0.98 ± 0.18, which leads to an upper limit of 80% for the probability of charge persistence of nucleons at energies $\sim$100 Bev in collisions with air nuclei. (A.G.W.)

40199 THE ORIGIN OF PIONS, MUONS AND PROTONS OF GREAT ENERGY. N. L. Grigorov, Yu. D. Kotov, and I. L. Rosental. p.265-7 of "International Conference on Cosmic Rays. Vol. 5." Bombay, Tata Inst. of Fundamental Research, 1964.

The possible part played by the energetic pions originating in the single nuclear interaction is discussed. The hyperon hypothesis and the Landau process are considered. It is concluded that the hyperon (or isobar) hypothesis is rather improbable. The possibility is suggested that the hydrodynamic theory is not applicable to all collisions but only to the so-called central collisions (~30-50%). (A.G.W.)

40200 ROLE OF FLUCTUATIONS OF NUCLEAR-ACTIVE PARTICLE INTERACTION CHARACTERISTICS IN SOME PROCESSES OBSERVED IN COSMIC RAYS AT HIGH ENERGIES. N. L. Grigorov and V. Ya. Shestoperov (Moscow State Univ.). p.268-75 of "International Conference on Cosmic Rays. Vol. 5." Bombay, Tata Inst. of Fundamental Research, 1964.

Figures show results of calculations of the following: energy spectra of nuclear-active particles at mountain altitude and at the boundary of the atmosphere; intensity of γ rays calculated for different inelasticity coefficients; the spectrum of high-energy muons generated in each of two processes; the positive excess of the vertical muon flux at sea level plotted for each of two processes; the differential energy spectrum of young air showers; dependence of $K_\pi^\gamma \epsilon^{-1}$ on the total energy transferred in an interaction to all neutral pions; and distribution in age parameter of extensive air showers. The two processes considered in all the calculations were the so-called pionization and catastrophic processes. It is concluded that the pionization process plays a rather insignificant role in a considerable number of processes relating to cosmic-ray high-energy processes. The main process in all events in which high-energy particles play a decisive role are the interactions with catastrophic energy losses characterized by an inelasticity coefficient close to unity and a small multiplicity of secondary pions, which carry away a larger part of the energy of a primary. (A.G.W.)

40201 ENERGY SPECTRA OF NUCLEAR-ACTIVE PARTICLES AT MOUNTAIN ALTITUDE. V. I. Yakovlev (Lebedev Inst. of Physics, Moscow). p.279-82 of "International Conference on Cosmic Rays. Vol. 5." Bombay, Tata Inst. of Fundamental Research, 1964.

Previously reported experiments of three groups on ionization bursts under an absorber are compared and combined. The results seem to confirm a change of the integral burst spectrum at an ionization interval corresponding to the passage of 4×10^4 relativistic particles through a chamber. An elementary act change at energy ~10^{14} ev is suggested. At energy <10^{14} ev the leading particle takes the major part of the energy. At energy >10^{14} ev the energy dissipation takes place between a few secondary particles. (A.G.W.)

40202 ABSORPTION OF HIGH ENERGY NUCLEONS IN THE ATMOSPHERE AND GENERATION OF MESONS. L. T. Baradzei, V. I. Rubtsov, Y. A. Smorodin, and M. V. Solovyov (Lebedev Inst. of Physics, Moscow and Moscow State Univ.). p.283-90 of "International Conference on Cosmic Rays. Vol. 5." Bombay, Tata Inst. of Fundamental Research, 1964.

The experimental data on cascades due to the nuclear-active component in the atmosphere and on γ rays were analyzed, and the main results are summarized. Data on the intensity of generation of nuclear cascades at various depths of atmosphere and on the primary nucleon spectrum are summarized in a figure, and expressions are derived to describe the observable fluxes of particle-generated nuclear cascades. The exponents of the γ-ray and nuclear-active particle production spectra are tabulated, and possible pion production mechanisms are considered. Pion and nucleon fluxes in the atmosphere are calculated, and the ratios of pion flux with given energy to nucleon flux with the same energy for different depths of atmosphere are tabulated. (A.G.W.)

40203 RECENT LARGE STACK INVESTIGATIONS OF HIGH ENERGY JETS. M. Koshiba (Tokyo Univ.). p.293-325 of "International Conference on Cosmic Rays. Vol. 5." Bombay, Tata Inst. of Fundamental Research, 1964.

The recent collaborational experiments on high-energy jets with two large stacks of nuclear emulsions, Schein stack (International Cooperative Emulsion Flight) and Brawley stack, are reviewed. Specific topics considered include Lorentz invariant quantity, mean free paths, various attempts at energy estimation, the problem of asymmetric emission, attempts to identify surviving baryons, inelasticity, multiplicity, and composition of the produced particles. The review is based mainly on papers to be published in Nuovo Cimento Supplimento. (A.G.W.)

40204 TRANSVERSE MOMENTUM OF γ-RAYS RESULTING FROM HIGH ENERGY NUCLEAR INTERACTIONS. S. Lal and A. Subramanian (Tata Inst. of Fundamental Research, Bombay). p.373-6 of "International Conference on Cosmic Rays. Vol. 5." Bombay, Tata Inst. of Fundamental Research, 1964.

An analysis of available data on the transverse momenta (P_T) of γ rays produced in nuclear interactions of nucleons and pions indicates that these distributions have an exponential tail that can be given by $\exp(-P_T/p_0)$, where p_0 is a constant. The values of average P_T and p_0 from various experiments are tabulated. Differences in the value of p_0 and the average P_T of the γ rays seem to be at angles <10° in the laboratory system. The difference in p_0 seems to be associated with the nature of the primary. Average P_T of γ rays in the pion interactions is significantly higher at primary energies of 6.1 Bev than at 17 Bev. It is concluded that the data can be explained on the basis of two distinct types of pion clouds with a large difference in the Q-value. (A.G.W.)

40205 A NEW APPROACH TO THE ANALYSIS OF VERY HIGH ENERGY INTERACTIONS. R. W. Huggett and K. Mori (Louisiana State Univ., Baton Rouge). p.387-91 of "International Conference on Cosmic Rays. Vol. 5." Bombay, Tata Inst. of Fundamental Research, 1964.

Some analysis methods are proposed, which use not only the polar emission angles θ_i made by the particles with respect to the primary direction, but also the azimuthal angles φ_i measured in a plane perpendicular to the primary direction. One proposal is for an effective-mass analysis of n-particle correlations for all n values up to the charged multiplicity n_s of the events studied. An approximate expression for the calculation of these effective masses is obtained by assuming that all particles have the pion mass μ and that the transverse momentum p_t of each particle is constant and equal to the mean value of the p_t distribution. The possibility of using this approach in connection with studies of the four-momentum transfer in jets is also discussed. (A.G.W.)

40206 SECONDARY COSMIC RADIATION AND MESON PRODUCTION AT HIGH ENERGIES. Yash Pal (Tata Inst. of Fundamental Research, Bombay). p.445-

59 of "International Conference on Cosmic Rays. Vol. 5." Bombay, Tata Inst. of Fundamental Research, 1964.

An attempt is made to correlate the regularities observed in the fluxes of particles in the secondary cosmic radiation with the possible existence of structures and dynamical relationships among particles created in the elementary act of collision. The results confirm the conclusion previously reached with the help of accelerator studies that meson production proceeds through two processes: (1) the excitation of baryon isobars each of which decays into an average of three mesons, and (2) evaporation of low-energy mesons from a fireball essentially at rest in the C-system of the collision. The first process accounts for most of the flux of the secondary cosmic radiation; the second process becomes significant only at very high energies (~100 Bev). Antimatter in primary cosmic rays and muon charge ratio at very high energies (>1000 Bev) are discussed briefly. (A.G.W.)

40207 HIGH ENERGY COSMIC RAY CASCADE IN THE ATMOSPHERE. S. Dagan (Israel Inst. of Tech., Haifa) and G. Yekutieli. p.460-3 of "International Conference on Cosmic Rays. Vol. 5." Bombay, Tata Inst. of Fundamental Research, 1964.

A model for the development of high-energy cosmic-ray cascades in the atmosphere is suggested. In nucleon-nucleon collisions at very high energies (>100 Bev), two fireballs and two excited baryons are produced along the primary direction. Most of the primary energy after the collision is carried by the forward moving excited baryon. The development of a cosmic-ray cascade can be described by successive collisions of this energetic baryon. The energy spectra of the various cosmic-ray components, as a function of the atmospheric depth, was obtained by integrating the cascade equation on a fast electronic computer. The results are summarized. (A.G.W.)

40208 A STUDY OF FOUR-MOMENTUM TRANSFER IN JETS EMPLOYING A MONTE CARLO CALCULATION. R. D. Settles (Louisiana State Univ., Baton Rouge). p.487-91 of "International Conference on Cosmic Rays. Vol. 5." Bombay, Tata Inst. of Fundamental Research, 1964.

A parameter deduced by Hasegawa and Yokoi (Uchûsen Kenkyu, 7: 186(1962)) is studied by a Monte Carlo method. This parameter, $|\Delta_1|$ determines a deliberate underestimate of the four-momentum transfer between two groups of produced particles from the jet angular distributions. The assumptions in the derivation of the expression for $|\Delta_1|$ and factors that influence its value are pointed out. Comparison of experimental and Monte Carlo $|\Delta_1|$ distributions shows that the experimental distribution peaks at a higher $|\Delta_1|$ value and has a more pronounced tail extending to high values of $|\Delta_1|$ than the Monte Carlo distributions. A comparison of $|\Delta_1|$ with $|\delta_1|$, the actual four-momentum transfer between two groups of produced particles of a jet, is also shown. (A.G.W.)

40209 A PHENOMENOLOGICAL STUDY OF VERY HIGH ENERGY INTERACTIONS. O. Czyzewski and A. Krzywicki (CERN, Geneva). p.492-7 of "International Conference on Cosmic Rays. Vol. 5." Bombay, Tata Inst. of Fundamental Research, 1964.

The phenomenological model presented is based on a statistical approach in which the properties of angular distribution are the results of constraints imposed on a phase space by the smallness of P_T and of the inelasticity, without ascribing to fireballs any dynamical meaning. General features of the angular distribution of pions and the problem of asymmetric jets are discussed briefly. (A.G.W.)

40210 PRELIMINARY RESULTS ON THE ANALYSIS OF SOME HIGH ENERGY JETS BY THE LOBACHEVSKY'S VELOCITY-PLOT. E. G. Bubelev (Joint Inst. for Nuclear Research, Dubna, USSR). p.577-80 of "International Conference on Cosmic Rays. Vol. 5." Bombay, Tata Inst. of Fundamental Research, 1964.

Some known high-energy jets were analyzed by a graphic method, which makes use of a plot which is an Euclidean image of the distribution of the colliding particles and their secondaries in the velocity-space rolled up around the axis. Results are presented as plots (called Lobachevsky's velocity-plots) of the analyzed events. (A.G.W.)

Criticality Studies

Refer also to abstract 39363.

40211 (K-D-1833) THE ELEMENTS OF NEUTRON INTERACTING ARRAYS. C. E. Newlon (Oak Ridge Gaseous Diffusion Plant, Tenn.). Aug. 19, 1964. Contract W-7405-eng-26. 15p. (CONF-666-1)

For Presentation at AEC Contractor Nuclear Materials Management Meeting, Gatlinburg, Tenn., Oct. 1964.

Calculational methods for criticality studies of arrays of individually subcritical units in air are discussed. Results are given for unreflected uranium metal cylinders for 93.2% enrichment. (R.E.U.)

40212 (LA-1209) MEASUREMENTS ON UNTAMPED ORALLOY ASSEMBLY. J. D. Orndoff and H. C. Paxton (Los Alamos Scientific Lab., N. Mex.). Feb. 8, 1951. Contract [W-7405-eng-36]. 33p.

The characteristics of an untamped pseudospherical Oy assembly (about 98% critical) were surveyed. Rossi α values were determined at two different neutron multiplications. relative fission rates in Oy and Tu were measured as a function of radius, and reactivity contributions per gm-atom of Oy, Pu, Tu, Pb, Ag, Cu and ^{10}B were obtained at various positions. Results are considerably less reliable than corresponding data for assemblies operable at delayed critical. (auth)

40213 (LA-1356(Del.)) PRECISION CRITICAL-MASS DETERMINATIONS FOR ORALLOY AND PLUTONIUM IN SPHERICAL TUBALLOY TAMPERS. G. E. Hansen and D. P. Wood (Los Alamos Scientific Lab., N. Mex.). Feb. 1, 1952. Contract [W-7405-eng-36]. 19p.

The results of precision delayed-critical-mass measurements on high density and high ^{235}U concentration oralloy cores close tamped in spherical tuballoy shells are given. The six critical-mass points obtained allow a reliable M_c vs Tu tamper thickness curve to be plotted. The results for Oy (93.9%), p = 18.75 gms/cm^3 are:

Tu thickness (in):	0	0.695	1.76	3.525	3.925	9.0
Oy critical mass (kg):	51.9	36.2	26.5	20.5	19.75	17.35

In addition, the M_c of Pu in a Tu tamper thickness of 4.603th in. was measured and found to be ~6.28 kg. (auth)

Direct Energy Conversion

Refer also to abstract 40806.

40214 (APL-TDR-64-92) HIGH-TEMPERATURE SOLAR THERMIONIC GENERATORS. (Thompson Ramo Wooldridge Inc. TRW Electromechanical Div., Cleveland). Aug. 31, 1964. Contract AF33(657)-11169. 233p. (ER-6044)

The results of solar evaluations of a 100-watt thermionic generator conducted under a solar flux range of 80 to 100 watts/ft^2 at the Jet Propulsion Laboratory's Table Mountain Test Site are presented. Generator performance optimization, misorientation, and cyclic and transient response tests were accomplished. Good correlation of the generator's solar performance with laboratory performance was obtained, and indicated that at the 130 watts/ft^2 solar flux level of outer space, the generator would be capable of achieving the full design power output of 100 watts. Generator power output was reduced up to 10% under a solar concentrator misorientation of 6 minutes of arc, illustrating the need for high accuracy concentrator orientation devices. In addition, results of cyclic and continuous life test of "practical hardware" thermionic converters are given for three design iterations. Discussions of design details and life-limiting characteristics of each design, through a two year development period, illustrate the progress made in extending the "continuous" life operation to over 3600 hours and "cyclic" life operation beyond 2900 deep thermal cycles. These converters employ a tantalum emitter operating at a design temperature of 2000°K and a molybdenum collector at 900°K. They are rated nominally at 16.5 watts at 1.0 volts or 24.8 watts at 3.0 volts. The preliminary design of a solar thermionic generator was also completed, and this design dictated the shape of the Series 310 converter emitter head to conform to a four-converter generator cavity wall. This generator, designed for cyclic operation in an orbital application, is rated at 66 watts at 4.0 volts or 108 watts at 3.0 volts. Because of the unexpected long life (approximately 3000 hours of continuous operation) demonstrated by converter 302, an alternate generator design, utilizing thermal energy storage was completed. In addition to alleviating severe thermal stresses to which the converters are subjected under cyclic operation, the added advantage of a reduced system specific weight (128 lbs/kw at the 3.0-kw level) can be realized by the development of thermionic generators incorporating thermal energy storage materials. (auth)

40215 (NRC-62-90) ELECTRON-ION RECOMBINATION IN MAGNETOPLASMADYNAMIC POWER GENERATORS. I. R. McNab and C. A. Robinson (Parsons (C. A.) and Co., Ltd., Newcastle-upon-Tyne, England). Sept. 1962. 30p. (AD-285289)

In inert gas-alkali metal vapor magnetoplasmadynamic (MPD) power generators employing an ionization level above that corresponding to thermal ionization at the static temperature of the plasma, recombination will be one of the main factors controlling the electric conductivity of the gas. A comprehensive review of recombination mechanisms indicates that, for the type of MPD generator mentioned, a three-body electron-electron-ion recombination process will be of greatest importance. For the case where the gaseous component of the MPD generator is di- or polyatomic, an alternative recombination mechanism is postulated (three-body electron-atom-ion) and a recombination coefficient derived; values of this coefficient are given as functions of mean electron energy for hydrogen, nitrogen, oxygen, and ammonia. (auth)

40216 WORLD ENERGY SOURCES AND RESOURCES. F. G. Bennett. Mining, Elec. Mech. Engr., 44: 287-94 (May 1964).

Capital sources of energy such as coal, oils, and natural gas, and income energy sources such as water, tides, and solar radiation are discussed. Graphs show rates of growth of production and utilization of various fuels, and a forecast is made of developments in MHD generation. (UKAEA)

40217 MAGNETO-GAS DYNAMIC GENERATORS FOR POWER INSTALLATIONS [COMPLETE]. K. I. Strakhovich. Power Express, 3: No. 5, 7-16(1964). Translated from Elektrichestvo, No. 9, 15-22(1963).

An outline is presented of power installations based on magnetogasdynamic generators. The thermodynamic and energy-loss characteristics of these magnetogasdynamic units are studied. (T.F.H.)

40218 THE FEASIBILITY OF LARGE SCALE MHD POWER GENERATION. S. Way and W. E. Young (Westinghouse Research and Development Center, Pittsburgh). 15p. (CONF-661-1)

From The Southwestern IEEE Conference and Electronics Show, Dallas, Apr. 1964.

It is possible to project the approximate cost of a fuel burning MHD-steam combination plant. It is very desirable to use a magnet of superconducting type. Since there is some uncertainty as to the future cost of large superconducting magnets, the power costs presented in this study will be expressed in terms of the unit cost of superconducting magnet wire. The MHD generator normally puts out direct current power. We shall give results for two cases, one in which this power is left in d.c. form and the other in which it is converted to a.c. In both cases, the steam "bottom" plant will generate a.c. power. The economics of an MHD-steam combined plant of moderate efficiency is discussed. A plant of higher efficiency is discussed, and results are shown. It will be seen that the moderate efficiency plant is more attractive. The economic advantages of producing calcium nitrates and nitrites as by-products from the MHD power plant are mentioned. Finally, the possible use of cesium rather than potassium seeding is mentioned. This leads to a considerable simplification of the air preheater problem. (auth)

40219 MHD—WORKHORSE OF THE FUTURE. W. S. Emmerich (Westinghouse Electric Corp., Pittsburgh). 18p. (CONF-661-2)

From The Southwestern IEEE Conference and Electronics Show, Dallas, Apr. 1964.

Laboratory studies aimed at the use of MHD for commercial electric power generation, space power and propulsion, and controlled nuclear fusion are described. (T.F.H.)

40220 AN EVALUATION OF PRIMARY ELECTRICAL POWER SUPPLIES IN THE ONE TO TEN WATT RANGE FOR LONG TIME REMOTE UNATTENDED TERRESTRIAL USE. Kenneth E. Mayo (Sanders Associates, Inc., Nashua, N. H.). 18p. (CONF-637-6)

From Institute of Electrical and Electronics Engineers Region 3 Annual Meeting and Technical Conference, Clearwater, Fla., May 1964.

The following nine classes of energy converters are evaluated on the bases of size, weight, reliability, relative cost including handling and storage, and availability: Seebeck generators, chemical fuel cells, Nernst generators, magneto-hydrodynamic or plasma generators, thermionic generators, photoelectric generators, batteries, electromechanical generators, and biochemical and bioelectric generators. It is concluded that electrochemical fuel cells and thermoelectric generators compete for optimum selection within the specified constraints. The disadvantage of fuel cells is that fuel is bulky and heavy compared to isotopes; however, when shielding for isotopes is considered, the choice may be marginal. (A.G.W.)

Elementary Particles and Radiations

Refer also to abstracts 39671, 39673, and 40397.

40221 (BNL-7973) NEUTRON-NUCLEON INTERACTIONS IN THE Gev-ENERGY REGION. H. Palevsky, J. L. Friedes, R. J. Sutter, R. E. Chrien, and H. R. Muether (Brookhaven National Lab., Upton, N. Y.). Apr. 1964. Contract AT-30-2-GEN-16. 6p. (CONF-502-2)

From International Congress of Nuclear Physics, Paris, July 1964.

The n-p differential scattering cross section at 2 and 3 Bev was measured in the backward direction and found to be sharply peaked at 180° (cms). From the half width of the experimental peak, it is concluded that the nucleon-nucleon force extends out to regions of at least 2 f. The properties of the n-p interaction were used to obtain a monochromatic beam of neutrons from the Brookhaven Cosmotron for use in a program of measurement of fundamental neutron interactions in the Bev energy region. Measurements of the n-p and n-d cross sections were completed with about 2 per cent accuracy. When compared to p-p and p-d measurements in the same energy region, the results indicate the validity of charge symmetry. The measured n-p total cross section is about 10 per cent smaller than the p-p cross section, at 2.2 Bev. (auth)

40222 (BNL-8230) SOME PROPERTIES OF K_1^0 AND K_2^0. T. Fujii, J. Jovanovich, F. Turkot (Brookhaven National Lab., Upton, N. Y.); G. T. Zorn (Maryland. Univ., College Park); and M. Deutsch (Massachusetts Inst. of Tech., [Cambridge]). July 10, 1964. Contract [AT(30-2)-Gen-16]. 9p. (CONF-550-32)

From the International Conference on High-Energy Physics, Dubna, USSR, Aug. 1964.

Several experiments were made on the K_1^0 regeneration phenomenon under various conditions. The lifetime of the K_1^0 meson was found to be $0.91 \pm 0.07 \times 10^{-10}$ sec, in good agreement with other values. The $K_1^0 - K_2^0$ mass difference $|\delta|$was determined to be 0.82 ± 0.12 $(\hbar/\tau_1)$, where $\tau_1 = 0.89 \times 10^{-10}$ sec, and the sign of δ was also determined. K_2^0 total cross sections and relative regeneration amplitudes were measured for C, Cu, Fe, and U. The lifetime of the K_2^0 meson was found to be 53 ± 5 nsec. (D.L.C.)

40223 (BNL-8231) THE Ω^-: PRODUCTION AND MASS. V. E. Barnes, P. L. Connolly, D. J. Crennell, et al. (Brookhaven National Lab., Upton, N. Y.). [1964]. Contract AT-30-2-GEN-16. 7p. (CONF-550-37)

From the International Conference on High-Energy Physics, Dubna, USSR, Aug. 1964.

The production of Ω^- in K^- + p interactions at 5 Bev/c was studied. The mass of Ω^- was determined from a histogram for K^0 and Ξ^- decays. (R.E.U.)

40224 (BNL-8232) QUANTUM NUMBERS OF THE Y* (1660). D. Berley, P. L. Connolly, E. L. Hart, D. C. Rahm, D. L. Stonehill, B. Thevenet, W. J. Willis, and S. S. Yamamoto (Brookhaven National Lab., Upton, N. Y.). July 13, 1964. Contract AT-30-2-GEN-16. 7p. (CONF-550-33)

From the International Conference on High-Energy Physics, Dubna, USSR, Aug. 1964.

A study was made of 4000 zero-prong plus V^0 and two-prong plus V^0 events containing the reactions $K^- + p \rightarrow \Lambda + \pi^0$ and $K^- + p \rightarrow \Lambda + \pi^+ + \pi^-$ for K^- momenta having total cms energies between 1620 and 1720 Mev. (R.E.U.)

40225 (BNL-8233) THRESHOLD PHENOMENA IN THE REACTION $K^- + p \rightarrow \Lambda + \eta$. D. Berley, P. L. Connolly, E. L. Hart, D. C. Rahm, D. L. Stonehill, B. Thevenet, W. J. Willis, and S. S. Yamamoto (Brookhaven National Lab., Upton, N. Y.). [1962]. Contract AT-30-2-GEN-16. 7p. (CONF-550-34)

From the International Conference on High-Energy Physics, Dubna, USSR, Aug. 1964.

The excitation function for the reaction $K^- + p \rightarrow \Lambda + \eta$ was investigated at energies near threshold (724 Mev/c for η mass of 548 Mev). Bubble chamber events provided the initial observations. (R.E.U.)

40226 (BNL-8234) PRODUCTION OF Ξ^- HYPERONS BY 5-Bev/c K^- MESONS. V. E. Barnes, B. B. Culwick (Brookhaven National Lab., Upton, N. Y.); M. Goldberg, et al. (Syracuse Univ., N. Y.). [nd]. Contract [AT(30-2)-Gen-16]. 6p. (CONF-550-24)

From the International Conference on High-Energy Physics, Dubna, USSR, Aug. 1964.

An analysis of events in a liquid-hydrogen bubble chamber subjected to 5-Bev/c K^- mesons is given. Results are given for Ξ^- production cross sections for 2- through 6-body channels. (R.E.U.)

40227 (BNL-8235) PRODUCTION OF ϕ AND ω IN ANTIPROTON-NEUTRON ANNIHILATIONS AT REST. V. E. Barnes (Brookhaven National Lab., Upton, N. Y.), P. Anninos (Syracuse Univ., N. Y.), S. Zenone, et al. (Rome. Universita). [1964]. Contract AT(30-2)-Gen-16. 7p. (CONF-550-35)

From the International Conference on High-Energy Physics, Dubna, USSR, Aug. 1964.

Production rates for $\bar{p}n \rightarrow \phi\pi^-$ and $\bar{p}n \rightarrow \omega\pi^-$ were studied for beams of stopping antiprotons in deuterium, the protons acting as spectators. (R.E.U.)

40228 (BNL-8237) MULTI-PION PRODUCTION BY NEGATIVE PIONS IN HYDROGEN AT 6 Bev/c. V. E. Barnes, W. B. Fowler, K. W. Lai, D. Radojicic, D. C. Rahm, M. S. Webster (Brookhaven National Lab., Upton, N. Y.), A. H. Bachman, P. Baumel, and R. M. Lea (City Coll., New York). [1964]. Contract AT(30-2)-Gen-16. 7p. (CONF-550-36)

From the International Conference on High-Energy Physics, Dubna, USSR, Aug. 1964.

Four-prong interactions were studied in a liquid-hydrogen bubble chamber subjected to 6-Bev/c π^- mesons. Mass spectra are shown for three- and four-meson production. (R.E.U.)

40229 (BNL-8239) REGENERATION AND DECAY OF K_2^0 MESONS IN LIQUID HYDROGEN. F. R. Eisler, T. C. Bacon, and H. W. K. Hopkins (Brookhaven National Lab., Upton, N. Y.). July 1964. Contract AT(30-2)-Gen-16. 8p. (CONF-550-51)

From the International Conference on High-Energy Physics, Dubna, USSR, Aug. 1964.

The decays and interactions of K_2^0 mesons in a liquid-hydrogen bubble chamber were studied to account for previously reported regeneration of K_1^0 mesons. The Q-values for the V-decays observed in the chamber are shown for energy ranges including K_{e3}^0, $K_{\mu 3}^0$, and $K_{2\pi}^0$. A Monte-Carlo calculation of the distribution to be expected from the V-A theory of K_{e3}^0 and $K_{\mu 3}^0$ is given. (R.E.U.)

40230 (BNL-8240) HYPERON PRODUCTION BY 7-Bev/c ANTIPROTONS IN HYDROGEN. C. Baltay, C. Y. Chien, J. Lach, J. Sandweiss, P. Slattery, H. Taft (Yale Univ., New Haven and Brookhaven National Lab., Upton, N. Y.), J. K. Kopp, Y. Oren, A. M. Thorndike, and M. S. Webster (Brookhaven National Lab., Upton, N. Y.). [1964]. Contract AT(30-2)-Gen-16. 11p. (CONF-550-38)

From the International Conference on High-Energy Physics, Dubna, USSR, Aug. 1964.

Preliminary results on hyperon production in antiproton-proton interactions at a laboratory momentum of 6.94 Bev/c are presented. A total of 2.72×10^5 meters of antiproton path length, corrected for attenuation and fiducial volume, was photographed in an 80-inch liquid hydrogen bubble chamber exposed to an electrostatically separated beam of antiprotons. The purity of the beam is determined from a comparison of the measured total cross-section with counter data to be 97%, assuming that the contamination is made up of μ^- mesons. The beam momentum is determined from kinematic analysis to be 6.94 with a spread of ±2%. In addition to the data at 6.94 Bev/c, recent data on similar reactions at 3.69 Bev/c are presented for comparison. (auth)

40231 (BNL-8241) A SEARCH FOR THE Ω HYPERON IN 7-Bev/c $\bar{p}$–p COLLISIONS. C. Baltay, C. Y. Chen (Yale Univ., New Haven and Brookhaven National Lab., Upton, N. Y.), D. J. Crennell, et al. (Brookhaven National Lab., Upton, N. Y.). [1964]. Contract AT(30-2)-Gen-16. 7p. (CONF-550-40)

From the International Conference on High-Energy Physics, Dubna, USSR, Aug. 1964.

Negative results are reported for a search for the Ω^- hyperon in antiproton-proton interactions in a liquid-hydrogen bubble chamber at 7 Bev/c. Kinematic considerations are discussed. (R.E.U.)

40232 (BNL-8242) K-MESON PRODUCTION IN $\bar{p}p$ ANNIHILATION AT 3.69 Bev/c. C. Baltay, J. Lach (Yale Univ., New Haven and Brookhaven National Lab., Upton, N. Y.), D. J. Crennell, et al. (Brookhaven National Lab., Upton, N. Y.). [1964]. Contract AT(30-2)-Gen-16. 11p. (CONF-550-39)

From the International Conference on High-Energy Physics, Dubna, USSR, Aug. 1964.

In a study of high-energy $\bar{p}p$ interactions, 250,000 pictures from the Brookhaven National Laboratory 20″ hydrogen bubble chamber exposed to a separated beam of 3.69-Bev/c antiprotons with a typical intensity of 15 $\bar{p}$ per pulse were examined. For the results reported, only events with at least one visible K_1^0 decay (into $\pi^+ + \pi^-$) were used. A total of 4050 such events were found and analyzed. Of these only 2175 events allowed unambiguous identification of the final state by kinematic fitting procedures and visual bubble density estimates. For the majority of the analysis presented, only the unambiguous events were used. A careful study indicates that the restriction to unambiguous events does not cause substantial distortion of effective mass spectra. (auth)

40233 (DESY-64/10) DRELL EFFECT AND GAUGE INVARIANCE. P. Stichel and M. Scholz (Germany. Physikalisches Staatsinstitut, Hamburg). July 1964. 12p.

It is shown that a gauge-invariance treatment is required for the Drell effect, i.e., the production of high-energy beams of strongly interacting particles as in the reaction $\gamma + p \rightarrow N^* + \pi^+$. (R.E.U.)

40234 (NP-14201) IZUCHENIE REAKTSII $\pi^- + p \rightarrow 2\pi^- + 2\pi^+ + k\pi^0 + n$ PRI IMPUL'SE PERVICHNYKE π^--MEZONOV 3.5 Bev. (Study of the Reaction $\pi^- + p \rightarrow 2\pi^- + 2\pi^+ + k\pi^0 + n$ with a Pulse of Primary Mesons 3.5 Bev/c). M. S. Ainvtdinov, S. M. Zombkovskii, Ya. M. Selektor, and V. N. Shuyachenko (Akademiya Nauk S.S.S.R. Institut Teoreticheskoi i Eksperimental'noi Fiziki, Moscow and U.S.S.R. Sovet Ministrov. Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii). 1964. 9p.

A hydrogen bubble chamber was used to study the reaction $\pi^- + p \rightarrow 2\pi^- + 2\pi^+ + k\pi^0 + n$ at 3.5 Bev/c. The effective-mass distribution of four charged mesons shows a peak at 1250 Mev. The distribution of missing mass to four charged mesons with effective mass in the peak region shows a peak in the region of $N_{3,3}$. (auth)

40235 (NP-14240) O VOZMOZHNOM SUSHCHESTVOVANII BOZONNOGO 27-SVERKHMULTIPLETA 1^+. (The Possible Realisation of the 27-Supermultiplet 1^+ for Bosons). V. V. Vludimirskii (Akademiya Nauk S.S.S.R. Institut Teoreticheskoi i Eksperimental'noi Fiziki, Moscow and U.S.S.R. Sovet Ministrov. Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii). 1964. 7p.

The set of the new boson resonances can be described in the framework of the 27-supermultiplet (27-fold way) of the unitary symmetry group. (auth)

40236 (NP-14242) IZMERENIYA ENERGETICHESKOI ZAVISIMOSTI DIFFERENTSIALNOGO SECHENIYA UPRUGOGO P-P RASSEYANIYA PRI ENERGIYAKH 3-9.5 Gev. (Measurements of Energy Dependence of Differential Cross section of Elastic p-p Scattering at 3- to 9.5 Gev). V. P. Kanavets, I. I. Levintov, B. V. Morozov, and N. A. Nikiforov (Akademiya Nauk S.S.S.R. Institut Teoreticheskoi i Eksperimental'noi Fiziki, Moscow and U.S.S.R. Sovet Ministrov. Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii). 1964. 10p.

Differential cross sections of elastic p-p scattering $d\delta/dt$ at 3 to 9.5 Bev at momenta $t = 0.108, 0.178, 0.258$, and 0.337-Bev^2 were measured. A considerable tapering of the diffraction cone for elastic p-p scattering was observed at 3 to 6 Bev; at higher energies the tapering was not observed. (R.V.J.)

40237 (NP-14244) POLYARIZATSIYA V UPRUGOM PROTON-PROTONNOM RASSEYANII PRI VYSOKIKH ENERGIYAKH. (Polarization in Elastic Proton-Proton Scattering at High Energies). A. P. Kanavets, I. I. Levintov, and B. V. Morozov (Akademiya Nauk S.S.S.R. Institut Teoreticheskoi i Eksperimental'noi Fiziki, Moscow and U.S.S.R. Sovet Ministrov. Gosudarstvennyi komitet po Ispol'zovaniyu Atomnoi Energii). 1964. 18p.

Measurements for incident protons at 4.9 to 8.5 Bev and $t \simeq 0.3\ \text{Bev}^2$ show that the magnitude of polarization decreases considerably with increased proton energy. An analysis of the data indicated that, of two possible causes of the decrease, reduced phase amplitude difference with or without spin flip is the more probable. An approximation formula for polarization in p-p scattering at high energies was developed on the basis of the common internucleon potential. (R.V.J.)

40238 (NP-14246) GRUPPY LI I SIMMETRIYA ELEMENTARNYKH CHASTITS. (Lie Groups and Symmetry of Elementary Particles). I. S. Shapiro and V. B. Mandel'tsveig (Akademiya Nauk S.S.S.R. Institut Teoreticheskoi i Eksperimental'noĭ Fiziki, Moscow and U.S.S.R. Sovet Ministrov. Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoĭ Energii). 1964. 80p.

Derivation of the main theorem determining the properties of semi-simple and simple groups is given. Some questions of the theory of SU_3 group representation are considered in detail. (auth)

40239 (NP-14293) REGENERATION OF K_1 MESONS AND THE K_1–K_2 MASS DIFFERENCE (thesis). Technical Report No. 34. James H. Christenson (Princeton Univ., N. J.). July 30, 1964. Contract Nonr-1858(06). 18p.

The regeneration of K_1 mesons in solid materials was studied using a beam of K_2 mesons produced at the Brook-

haven AGS. A pair of magnet-spark chamber spectrometers were employed to momentum-analyze the pions from the K_1 decays. Using copper regenerators, the transmission regeneration is found to indeed be coherent. The mass difference was measured with a regenerator consisting of two pieces of copper, separated by a gap of variable width. This method is independent of all nuclear parameters and yields a mass difference of 0.50 ± 0.10. Two independent analyses of data taken with various thicknesses of copper as regenerators, yield mass differences consistent with the gap measurement. Mass differences larger than 1 are strongly rejected by our data. The forward regeneration cross section for C, Cu, Fe, and W were measured and found to agree with optical model calculations. All data find explanation within the framework of the regeneration theory. (auth)

40240 (UCRL-11423) PRODUCTION OF NUCLEON ISOBARS BY 7-Bev/c PROTONS. C. M. Ankenbrandt, A. R. Clyde, Bruce Cork, D. Keefe, L. T. Kerth, W. M. Layson, and W. A. Wenzel (California. Univ., Berkeley. Lawrence Radiation Lab.). July 10, 1964. Contract W-7405-eng-48. 16p. (CONF-550-14)

From the International Conference on High-Energy Physics, Dubna, USSR, Aug. 1964.

The missing mass spectrum of nucleon isobars produced in the reaction $p + p \rightarrow N^* + p$ by 7-Bev/c protons incident on a liquid-hydrogen target was measured. Scintillation counters detected the scattered protons after momentum analysis. Cross sections were obtained for production of isobars of mass 1238, 1512, and 1688 Mev at momentum transfers of 0.09, 0.15, 0.24, 0.33, and 5 $(Bev/c)^2$. For low momentum transfer, the spectrum has additional structure at a mass of about 1430 Mev. The $T = \frac{1}{2}$ isobar production cross sections at $-t = 5$ $(Bev/c)^2$ are comparable with the elastic-scattering cross section. (auth)

40241 (UCRL-11424(Rev.)) PRODUCTION OF S = 0, -1 RESONANT STATES IN K^-p INTERACTIONS AT 2.45 Gev/c. Ronald R. Ross, Jerome H. Friedman, Daniel M. Siegel, et al. (California. Univ., Berkeley. Lawrence Radiation Lab.). July 7, 1964. Contract W-7405-eng-48. 18p. (CONF-550-31)

From the International Conference on High-Energy Physics, Dubna, USSR, Aug. 1964.

Cross sections are given for production of resonances in reactions $K^- + p \rightarrow \Lambda + \pi^+ + \pi^-$ and $K^- + p \rightarrow \Lambda + \pi^+ + \pi^0 + \pi^-$ at 2.45 Bev/c. The production of Y_1^* (1385) and ρ in $K^-p \rightarrow \Lambda\pi^+\pi^-$ and of Y_1^*, ρ, and ω in $K^-p \rightarrow \Lambda\pi^+\pi^0\pi^-$ was studied. (R.E.U)

40242 (UCRL-11427) DECAY PROPERTIES OF THE Ξ^- HYPERON. Philippe Eberhard, Janice Button-Shafer, and Deane W. Merrill (California. Univ., Berkeley. Lawrence Radiation Lab.). July 3, 1964. Contract W-7405-eng-48. 8p. (CONF-550-26)

From the International Conference on High-Energy Physics, Dubna, USSR, Aug. 1964.

The spin of the Ξ^- was investigated by analysis of $K^- + p \rightarrow \Xi^- + K^+$ events for incident meson momentum of 2.5 Bev/c in a bubble chamber. A maximum-likelihood treatment and an averaging technique were used for events where the Ξ^- decays into a visible Λ. (R.E.U.)

40243 (UCRL-11428(Rev.)) SEARCH FOR $\Phi \rightarrow \mu^+\mu^-$. Angela Barbaro-Galtieri and Robert D. Tripp (California. Univ., Berkeley. Lawrence Radiation Lab.). July 31, 1964. Contract W-7405-eng-48. 11p. (CONF-550-50)

From the International Conference on High-Energy Physics, Dubna, USSR, Aug. 1964.

The reactions $K^-p \rightarrow \Lambda\mu^+\mu^-$ and $K^-p \rightarrow \Lambda e^+e^-$ were studied experimentally in a hydrogen bubble chamber at 2.4 and 2.7 Bev/c incident K^- momentum. The φ resonance at 1020 Mev (1^-) is suggested to fill the role of a vector field or particle χ in an interaction discussed by Ne'eman; it is concluded that χ cannot explain the muon's mass. (R.E.U.)

40244 (UCRL-11429) THE K^-p CHARGE-EXCHANGE REACTION AT 2.45-, 2.63-, AND 2.70 Gev/c. Angela Barbaro-Galtieri and Robert Tripp (California. Univ., Berkeley and California. Univ., Berkeley. Lawrence Radiation Lab.). July 8, 1964. Contract W-7405-eng-48. 12p. (CONF-550-25)

From the International Conference on High-Energy Physics, Dubna, USSR, Aug. 1964.

Bubble chamber results are given for the reaction $K^-p \rightarrow \bar{K}^0n$ at 2.4, 2.6, and 2.7 Bev/c. Mass distributions and cross sections are discussed. (R.E.U.)

40245 (UCRL-11440) POLARIZATION IN PROTON-PROTON SCATTERING USING A POLARIZED TARGET. PART I. 0.330 TO 0.740 Gev. Frederick W. Betz, John F. Arens. PART II. 1.70 TO 6.15 Gev. Herbert M. Steiner, et al. (California. Univ., Berkeley. Lawrence Radiation Lab.). June 24, 1964. Contract W-7405-eng-48. 14p. (CONF-550-16)

From the International Conference on High-Energy Physics, Dubna, USSR, Aug. 1964.

The polarization parameter for p-p interactions was measured at beam energies of 0.330 to 6.15 Bev using the $La_2Mg_3(NO_3)_{12} \cdot 24H_2O$ polarized target. Angular measurements were made at 20 to 100° cms and four-momentum transfers of 0.1 to 0.8 $(Bev/c)^2$. Theoretical interpretations are discussed. (R.E.U.)

40246 (UCRL-11443) PRODUCTION AND DECAY OF BOSON RESONANT STATES IN π^- + p INTERACTIONS AT 3.2 Gev/c. Richard I. Hess, Suh Urk Chung, Orin I. Dahl, Lyndon M. Hardy, Janos Kirz, and Donald H. Miller (California. Univ., Berkeley. Lawrence Radiation Lab.). July 3, 1964. Contract W-7405-eng-48. 15p. (CONF-550-21)

From the International Conference on High-Energy Physics, Dubna, USSR, Aug. 1964.

Production and decay correlations for the $\pi\omega$ resonance at 1220 Mev (B meson), the $\pi\rho$ state at 1090 Mev (A_1 meson), and the $\pi\rho$ state at 1310 Mev (A_2 meson) were studied in detail. Interpretations are presented in terms of possible quantum number assignments. In addition, evidence for the existence of other decay modes for the A_2 meson state, i.e., $A_2 \rightarrow K\bar{K}$ and $A_2 \rightarrow \pi\eta$ is discussed. (auth)

40247 (UCRL-11445) STUDY OF MULTIPARTICLE RESONANCES IN THE π^+p INTERACTION AT 3.65 Bev/c. Gerson Goldhaber, Sulamith Goldhaber, Thomas A. O'Halloran, and Benjamin C. Shen (California. Univ., Berkeley. Lawrence Radiation Lab.). July 22, 1964. Contract W-7405-eng-48. 17p. (CONF-550-43)

From the International Conference on High-energy Physics, Dubna, USSR, Aug. 1964.

The resonance structures present in the four-particle final state in the interaction $\pi^+ + p \rightarrow \pi^+ + \pi^- + \pi^+ + p$ are discussed. Four possible channels that lead to these particles in the final state are examined. (J.R.D.)

40248 (UCRL-11464) π^-p INTERACTION AT 3.7 Bev. Sulamith Goldhaber, Gerson Goldhaber, Benjamin C. Shen, and George H. Trilling (California. Univ., Berkeley. Lawrence Radiation Lab.). July 16, 1964. Contract W-7405-eng-48. 14p. (CONF-550-44)

From the International Conference on High-Energy Physics, Dubna, USSR, Aug. 1964.

Data obtained from an experiment conducted in a momentum-analyzed bevatron negative beam using a 72-in. H_2 bubble chamber as detector are discussed. The reaction $\pi^- + p \rightarrow \pi^-\pi^+p\pi^-$ is examined. Kinematic fitting and ionization information is used to reduce the number of events with ambiguous interpretation to less than 1%. (J.R.D.)

40249 (UCRL-11493) REVIEW OF RECENT WORK ON K^- MESON INTERACTIONS. M. L. Stevenson (California. Univ., Berkeley. Lawrence Radiation Lab.). June 24, 1964. Contract W-7405-eng-48. 63p. (CONF-669-1)

From Conference on Particle Physics, Boulder, Colo., June-July 1964.

A summary of present information concerning the production characteristics of the many outgoing two-body channels in the $K^- - p$ system is presented. References concerning each of the reactions are included. (J.R.D.)

40250 (UCRL-11499) NON-REGGE TERMS IN THE VECTOR CHANNEL OF THE VECTOR-SPINOR THEORY. S. Mandelstam (California. Univ., Berkeley. Lawrence Radiation Lab. and California. Univ., Berkeley). June 15, 1964. Contract W-7405-eng-48. 7p. (CONF-550-20)

From the Internation Conference on High-Energy Physics, Dubna, USSR, Aug. 1964.

It is shown that the vector channel, unlike the spinor channel, is not exceptional; there is a Kronecker-delta term in the channel. Two- and three-particle intermediate states in the vector-meson channel are considered. (R.E.U.)

40251 (UCRL-11516) TOTAL CROSS SECTIONS AND DIFFRACTION SCATTERING IN THE 10–100 Gev RANGE ACCORDING TO THE STRIP APPROXIMATION. Geoffrey F. Chew and Vigdor L. Teplitz (California. Univ., Berkeley. Lawrence Radiation Lab.). June 19, 1964. Contract W-7405-eng-48. 9p. (CONF-550-30)

From the International Conference on High-Energy Physics, Dubna, USSR, Aug. 1964.

The strip approximation to strong interaction dynamics assumes a close connection to exist between small momentum transfer reactions ($\lesssim$2 Bev) at high energies ($\gtrsim$10 Bev) and the bound states and resonances observed at low energies ($\lesssim$2 Bev). In the most up to date formulation both phenomena are supposed to be controlled by a relatively small number of high ranking Regge trajectories. An attempt was made to solve bootstrap equations that will generate these trajectories and the associated residues. Although this program is still in an early stage, indications that the observed high-energy diffraction scattering is in fact dominated by the top ranking Regge pole were found. (auth)

40252 (UCRL-11537) SCATTERING OF 250-Mev POSITIVE PIONS BY PROTONS: EXPERIMENT AND ANALYSIS (thesis). Wladyslaw Kilian Troka (California. Univ., Berkeley. Lawrence Radiation Lab.). Sept. 18, 1964. Contract W-7405-eng-48. 102p.

The differential cross section for elastic scattering of positive pions on protons was measured at a nominal incident-meson kinetic energy of 250 Mev. The angular range covered in the center of mass by the 13 data points was 14.9 to 160°. The fractional rms errors were typically 1.5%. A liquid hydrogen target was bombarded by a beam of 2.5×10^6 mesons/sec. The scattered pions were detected by a counter telescope. Recoil protons were eliminated by means of a Cherenkov counter. A phase-shift analysis was performed combining the above-mentioned data with the recoil-proton polarization measurements taken recently with the help of a polarized proton target. Only one acceptable SPD Fermi-type phase-shift set was found. When F waves were included, a total of three possible phase-shift solutions emerged from the analysis. However, arguments based on the data could still be made to eliminate all but one phase-shift set. On the other hand, the remaining phase-shift set, similar in type to the SPD solution, suffers from the disadvantages of large rms errors assigned to its small phase shifts. (auth)

40253 (UCRL-11543(Rev.)) MEASUREMENT OF THE N^{*-}-N^{*++} MASS DIFFERENCE. George Gidal, Anne Kernan, and Sedong Kim (California. Univ., Berkeley. Lawrence Radiation Lab.). July 4, 1964. Contract W-7405-eng-48. 11p. (CONF-550-23)

From the International Conference on High-Energy Physics, Dubna, USSR, Aug. 1964.

The mass splitting in the $^3/_2{}^+$ isospin decuplet in SU3 was investigated using the reactions $n + n \rightarrow n + p + \pi^-$ and $p + p \rightarrow n + p + \pi^+$, which proceed entirely via N^{*-} and N^{*++}, respectively, in the energy region studied. The reactions were achieved simultaneously by interactions of 3.68-Bev/c deuterons with deuterium in a bubble chamber. (R.E.U.)

40254 (UCRL-11556) π^-p INTERACTIONS AT 3.9 Gev/c. Robert W. Birge, Robert P. Ely, Jr., Thomas Schumann (California. Univ., Berkeley. Lawrence Radiation Lab.); Zaven G. T. Guiragossian, and Marian N. Whitehead (Stanford Univ., Calif. Stanford Linear Accelerator Center). July 7, 1964. Contract W-7405-eng-48. 10p. (CONF-550-13)

From the International Conference on High-Energy Physics, Dubna, USSR, Aug. 1964.

Two- and four-prong reactions from $\pi^- + p$ at 3.9 Bev/c were studied in a hydrogen bubble chamber. Results are given for events leading to $\pi^+ + \pi^- + n$ and $\pi^- + \pi^0 + p$. Mass distributions are shown. (R.E.U.)

40255 (UCRL-11577) PION-NUCLEON SCATTERING IN THE $T = ^1/_2$ STATE AS DEDUCED FROM RECENT EXPERIMENTS. Burton J. Moyer (California. Univ., Berkeley and California. Univ., Berkeley. Lawrence Radiation Lab.). July 1964. Contract W-7405-eng-48. 10p. (CONF-550-47)

From the International Conference on High-Energy Physics, Dubna, USSR, Aug. 1964.

A review is presented of recent experiments involving elastic $\pi^\pm - p$ scattering at 300 to 700 Mev, charge-exchange scattering at 500 to 1300 Mev, and polarization measurements at 500 to 1000 Mev. (R.E.U.)

40256 (UJV-1060/64) REAKTSIYA OBRAZOVANIYA POZITRONIYA V GAZAKH. (Reaction Producing Positronium in Gases). M. Gmitro (Smitro) (Československá Akademie Ved. Ústav Jaderného Výzkumu, Řež). [1962]. 9p.

Investigation of positronium angular distributions in the pickup reactions positron-positronium in gases is considered as a new method of study of the electron wave functions in molecules. The methods of direct nuclear reactions were used. The Born approximation is used. Angular distributions are distinct for the reactions with electrons from "atomic" and "molecular" orbits. The most advantageous region of positron energy is 20 to 100 ev. (auth)

40257 A GENERALIZATION OF THE CONNECTION OF SPIN FOR THE NONLOCAL CASE. Tiberiu I. Toro (Univ. of Timisoara, Romania). Compt. Rend., 259: 307-9(July 15, 1964). (In French)

The Tvanenko-Fock coefficients of spin connection are generalized for the case of the closely related connection of nonlocal spin. The Dirac equation in the presence of gravitation is written for this case. (tr-auth)

40258 CALCULATION OF THE PRODUCTION OF PAIRS OF MUONS AT THE ENERGY OF THE FIRST RESONANCE. Asit Bhattacharya and Paul Kessler (College de France, Paris). Compt. Rend., 259: 310-13 (July 15, 1964). (In French)

The process in which an N* resonance formed in a π-N collision decays into a nucleon and a pair of muons was considered. The calculation of the corresponding diagram showed the role of the form factor of the vertex γNN^* in a domain in which the photon is of the time type and very close to its mass layer (q^2 between 1 and 2 Γ^{-2}). (tr-auth)

40259 A CONNECTION BETWEEN THE MASSES OF ELEMENTARY PARTICLES. A. Polikarov. Compt. Rend. Acad. Bulgare Sci., 17: 385-6(1964).

After ordering the elementary particles according to their (approximate) masses (in units of electron mass)

$$m_1 = 0, \quad m_2 = 1, \quad m_3 = 207, \quad m_4 = 273,$$
$$m_5 = 607, \quad m_6 = 974, \quad m_7 = 1080, \quad m_8 = 1470,$$
$$m_9 = 1490, \quad m_{10} = 1700, \quad m_{11} = 1839, \quad m_{12} = 2182,$$
$$m_{13} = 2340, \quad m_{14} = 2580, \quad m_{15} = 2715, \quad m_{16} = 2755,$$

the following two relations are established:

$$(1)\quad \begin{aligned} m_1 + m_3 + m_5 + m_7 + m_{10} + m_{12} + m_{14} + m_{16} &= 11111 \\ m_2 + m_4 + m_6 + m_8 + m_9 + m_{11} + m_{13} + m_{15} &= 11102. \end{aligned}$$

$$(2)\quad \begin{aligned} m_1 + m_5 + m_{12} + m_{16} &\approx \\ m_2 + m_6 + m_{11} + m_{15} &\approx \\ m_3 + m_7 + m_{10} + m_{14} &\approx \\ m_4 + m_8 + m_9 + m_{13} &\approx 5556 \end{aligned}$$

There are 3 Soviet and 3 Western references. (OTS)

40260 ELEMENTARY PARTICLES 1963. Arne Lundby (CERN, Geneva). ICSU (Intern. Council Sci. Unions) Rev. World Sci., 6: 35-43(Jan. 1964).

The elementary particles known in 1963 are described and classified. (D.C.W.)

40261 ON CERTAIN PROPERTIES OF POSITRON EMISSION INDUCED BY AN ANTINEUTRINO FLUX ON PROTONS ($\bar{\nu} + p \rightarrow n + \bar{e}$). G. V. Shishkin (Inst. of Heat and Mass Exchange). Izv. Vysshikh Uchebn. Zavedenii, Fiz., No. 2, 31-8(1964). (In Russian)

Properties of positron emission in $\bar{\nu} + p \rightarrow n + \bar{e}$ reactions were studied, and expressions were developed for process probability under various initial conditions. Polarization of the positrons was also considered. Expressions for polarization vector show that the longitudinal polarization increases with positron energy. In cases in which proton spin is directed along the antineutrino momentum, $s_{pz} = \pm 1$, $s_{px} = s_{py} = 0$ (where s_{px}, s_{py}, s_{pz} are the proton spin projections along coordinate axes) or the proton field is not polarized, the positron polarization vector is found in the antineutrino and positron momentum plane. (R.V.J.)

40262 INTERACTION OF NONRELATIVISTIC PARTICLES WITH A QUANTIZED SCALAR FIELD. Edward Nelson (Princeton Univ., N. J.). J. Math. Phys. (N. Y.), 5: 1190-7(Sept. 1964).

The mathematical existence of a meson theory with nonrelativistic nucleons is demonstrated. A system of Schrödinger particles is coupled to a quantized relativistic scalar field. If a cutoff is put on the interaction, a well-defined self-adjoint operator is obtained. The solution of the Schrödinger equation diverges as the cutoff tends to infinity, but the divergence amounts merely to a constant infinite phase shift due to the self-energy of the particles. In the Heisenberg picture, a solution in the limit of no cutoff is obtained. A canonical transformation due to Gross is used to separate the divergent self-energy term. It is shown that the canonical transformation is implemented by a unitary operator, and that the transformed hamiltonian, with an infinite constant subtracted, can be interpreted as a self-adjoint operator. (auth)

40263 COMMENTS ON NONLINEAR WAVE EQUATIONS AS MODELS FOR ELEMENTARY PARTICLES. G. H. Derrick (Univ. of New South Wales, Kensington, Australia). J. Math. Phys. (N. Y.), 5: 1252-4(Sept. 1964).

It is shown that for a wide class of nonlinear wave equations there exist no stable time-independent solutions of finite energy. The possibility is considered whether elementary particles might be oscillating solutions of some nonlinear wave equation, in which the wavefunction is periodic in the time though the energy remains localized. (auth)

40264 TRIALITY TYPE AND ITS GENERALIZATION IN UNITARY SYMMETRY THEORIES. C. R. Hagen and A. J. Macfarlane (Univ. of Rochester, N. Y.). J. Math. Phys. (N. Y.), 5: 1335-9(Sept. 1964). (UR-875-27)

Within the context of an extension of the SU_3-symmetry theory certain aspects of the theory of the special unitary groups are examined. The plurality type of a given representation is introduced as the generalization of the triality concept to SU_{n+1} and is shown to be associated with a multiplicative conservation law. Theorems for the reduction of representations of SU_{n+1} with respect to $SU_n \otimes U_1^{(n)}$ are derived which are subsequently used to relate plurality type to the existence of fractional eigenvalues for the generator $Y_1^{(n)}$ of $U_1^{(n)}$. (auth)

40265 SOLUTION OF A SINGULAR INTEGRAL EQUATION FROM SCATTERING THEORY. R. P. Kenschaft and R. D. Amado (Univ. of Pennsylvania, Philadelphia). J. Math. Phys. (N. Y.), 5: 1340-2(Sept. 1964).

The solution of a singular integral equation of the form $\psi(\omega,\omega_0) = -(1/\omega) - (1/\pi)\int_\mu^\infty [\rho(\omega_1,\omega_0)\psi(\omega_1,\omega_0)\, d\omega_1/\omega_1 + \omega - \omega_0 - i\epsilon]$ is obtained. The equation first appeared in the attempt of Källén and Pauli to solve $V-\theta$ scattering in the Lee model. The methods to solve that problem are turned to solving the integral equation itself. (auth)

40266 THE CLEBSCH-GORDAN SERIES FOR SU(3). Sidney Coleman (Harvard Univ., Cambridge, Mass.). J. Math. Phys. (N. Y.), 5: 1343-?(Sept. 1964).

A method is explained for the calculation of the reduction of direct products of irreducible representations of SU(3). The method is believed to be simpler and more efficient than the usual algorithms. (auth)

40267 THE PRODUCTION OF $K^0\bar{K}^0$ PAIRS BY 10 Gev/c NEGATIVE PIONS ON PROTONS. A. Bigi, S. Brandt, A. de Marco-Trabucco, Ch. Peyrou, R. Sosnowski, and A. Wróblewski (CERN, Geneva). Nuovo Cimento (10), 33: 1249-64(Sept. 1, 1964).

On 83,000 photographs from an exposure of the 81 cm Saclay hydrogen bubble chamber to a 10 Bev/c π^- beam of the CERN proton synchrotron, 63 events were found showing a beam interaction in a fiducial region of the chamber and the decay of two neutral kaons from this interaction. The cm distributions of all produced particles are given. It was found that nucleons are emitted strongly backward in the cms while both kaons show a pronounced forward emission. Pions are emitted with small momenta nearly isotropically. None of the known kaon or nucleon isobars is strongly produced, whereas a peaking of the ($K_1^0K_1^0$) Q-

value is observed at ~50 Mev. The average transverse and total cm momenta increase with the mass of the produced particles. (auth)

40268 ON THE ASSOCIATED PRODUCTION OF K – Y PAIRS BY 10 Gev/c π^- IN THE HYDROGEN BUBBLE CHAMBER. A. Bigi, S. Brandt, A. de Marco-Trabucco, Ch. Peyrou, R. Sosnowski, and A. Wróblewski (CERN, Geneva). Nuovo Cimento (10), 33: 1265-86(Sept. 1, 1964).

A sample of 199 events of the type $\pi^- + p \rightarrow K + Y + n\pi$, 12 events of the type $\pi^- + p \rightarrow \Xi^- + 2K + n\pi$ and 3 events with the production of a hyperon-antihyperon pair were found in a fiducial region of the 81 cm Saclay hydrogen bubble chamber exposed to a beam of 10-Bev/c π^-. The Λ hyperons, and to a lesser extent, the Σ^+ hyperons were found to be emitted strongly backward in the cms of the collision, whereas Σ^- hyperons are emitted more isotropically. Kaons are emitted in most cases strongly forward, whereas pions are produced with small cm momenta nearly isotropically. The known resonances K^*_{888}, Y^*_{1385}, Y^*_{1405}, Y^*_{1820}, and Ξ^*_{1535} are observed only in a small fraction of the events and so they do not seem to dominate the associated production at this high energy. The transverse and total cm momenta increase with the mass of the particles produced. (auth)

40269 ELASTIC π^+p SCATTERING AT 1.6 Gev/c. A. Daudin (Laboratoire de Physique Corpusculaire a Haute Energie, Saclay, France), M. A. Jabiol, C. Kochowski, C. Lewin, A. Rogozinski, S. Mongelli, V. Picciarelli, A. Romano, and P. Waloschek. Nuovo Cimento (10), 33: 1300-8(Sept. 1, 1964).

The cm angular distribution of π^+p elastic scattering at 1.6 Bev/c shows a strong forward diffraction peak decreasing exponentially with a slope $A_+ = (6.9 \pm 0.5)$ Bev^{-2} comparable to that $A_- = (7.2 \pm 0.5)$ Bev^{-2} observed in a previous experiment for π^-p elastic scattering at the same incident momentum. The behavior of the π^+ and the π^- angular distributions is quite different beyond the diffraction peak. The π^+p total elastic cross section is found to be $\sigma_{el} = (16.70 \pm 0.45)$ mb. (auth)

40270 FRACTIONALLY CHARGED PARTICLES IN THE SU_3 MODEL. L. C. Biedenharn and E. C. Fowler (Duke Univ., Durham, N. C.). Nuovo Cimento (10), 33: 1329-32(Sept. 1, 1964).

The concept of triality type for SU_3 is discussed in connection with the recent suggestion of Gell-Mann on fractionally charged particles. The significance of triality for interactions is emphasized. (auth)

40271 U-SPIN AND THE WEAK INTERACTION. P. T. Matthews and Abdus Salam (Imperial Coll. of Science and Tech., London). Nuovo Cimento (10), 33: 1333-7(Sept. 1, 1964).

The notion of U-spin is applied to the semi-leptonic decays of the baryons. (auth)

40272 HERMITIAN ANALYTICITY AND EXTENDED UNITARITY IN S-MATRIX THEORY. J. B. Boyling (Cambridge Univ., Eng.). Nuovo Cimento (10), 33: 1356-73 (Sept. 1, 1964).

It is shown that the apparent contradiction between Olive's method of proof of hermitian analyticity and the existence of anomalous thresholds disappears on a closer examination of the singularity structure of multiparticle amplitudes. By making use of the hierarchy property of the Stapp-Polkinghorne singularity structure implied by maximal analyticity, hermitian analyticity and extended unitarity are proved for a scattering amplitude exhibiting anomalous threshold behavior and for an equal-mass production amplitude. (auth)

40273 ANALYTICITY IN THE ANGULAR MOMENTUM FOR SINGULAR POTENTIALS. M. Giffon (Université, Lyon) and E. Predazzi. Nuovo Cimento (10), 33: 1374-90 (Sept. 1, 1964).

The analytic properties in the angular momentum variable of the Jost functions and of the partial-wave S-matrix elements are investigated for a large class of repulsive potentials behaving near the origin as arbitrary inverse powers of the radial variable dominating over the centrifugal term. The asymptotic behavior of the Jost function for large angular momenta is obtained by means of a W.K.B. analysis, and the implications of the asymptotic distribution of poles in the λ-plane on the possibility of writing a Mandelstam representation are also briefly discussed. (auth)

40274 ELASTIC DEUTERON REACTIONS IN THE IMPULSE APPROXIMATION. M. Gourdin (Laboratoire de Physique Theorique et Hautes Energies, Orsay, France). Nuovo Cimento (10), 33: 1391-1406(Sept. 1, 1964).

Deuteron elastic reactions calculated with the help of the impulse approximation applied in the deuterium Breit system are discussed. The problem is completely symmetrical between initial and final states. An approximate covariant formulation is proposed using a convenient nonrelativistic deuterium wave function. Applications to electron–deuteron and meson–deuteron elastic scattering and to π^0 coherent photoproduction on deuterons are considered. (C.E.S.)

40275 THE DOUBLE-PERIPHERAL MODEL, AND ITS APPLICATION TO INELASTIC PION-NUCLEON COLLISIONS. J. Joseph (Universite, Geneva) and H. Pilkuhn. Nuovo Cimento (10), 33: 1407-21(Sept. 1, 1964).

The double-peripheral model is discussed and applied to four pion-nucleon reactions producing respectively a π^0, π^+, ω, and ρ^0. The results for the first two reactions are compared with a recent experiment at 4 Bev/c, and some additional predictions are given. (auth)

40276 GROUP-THEORETICAL APPROACH TO THE RELATIVISTIC LIMIT OF PARTICLE EQUATIONS. F. Strocchi (Scuola Normale Superiore, Pisa Italy and Università, Pisa Italy). Nuovo Cimento (10), 33: 1437-45(Sept. 1, 1964).

Representations of the generators of the Lorentz group for massless and massive particles are obtained, which are indistinguishable when, in the latter case, one has $m \ll p$. By using this representation the equations for massive particles have the same form as the equations for massless particles. The position operator, the spin, the generator of the pure Lorentz transformations, etc., and their relativistic limit are discussed, for both the spin one-half and the spin-one case. (auth)

40277 AN EXAMPLE OF $K_2^0 \rightarrow \pi^0 + \pi^0 + \pi^0$ DECAY. E. Bellotti and A. Pullia (Università, Milan and Instituto Nazionale di Fisica Nucleare, Milan). Nuovo Cimento (10), 33: 1462-5(Sept. 1, 1964).

Evidence for a decay of the type $K^0 \rightarrow \pi^0 + \pi^0 + \pi^0$ is reported. The event was found in a liquid bubble chamber filled with heavy freon and exposed to a 900-Mev/c meson (K^+) beam. (C.E.S.)

40278 ELECTROPRODUCTION AT THE LIMIT OF VERY HIGH ENERGIES. M. Lacombe and E. Predazzi (Università, Turin and Istituto Nazionale di Fisica Nucleare, Turin). Nuovo Cimento (10), 33: 1466-71(Sept. 1, 1964).

The inelastic cross section for electron scattering on nucleons is investigated by comparing it to photoproduction reactions involving photon interaction with nucleons. The

behavior of the inelastic cross section for electroproduction as a function of energy and of momentum transfer was determined. It is shown that the constant asymptotic behavior found for the longitudinal and the transversal cross sections with respect to the energy has the same origin as the analogous result one finds in the πN scattering according to the Regge-pole theory or to the multiperipheral model. It was found that the dependence on momentum transfer appears as a characteristic feature of the chosen model. (C.E.S.)

40279 NAMBU-FRÖHLICH MASS RULE AND OKUBO-GELL-MANN MASS FORMULAE. M. Umezawa (Institut de Recherches Nucléaires, Strasbourg). Nuovo Cimento (10), 33: 1481-3(Sept. 1, 1964).

An equation is given that relates the Nambu-Fröhlich mass rule and the Okubo-Gell-Mann mass formula. An equation for the masses of the elementary particles and resonances is also presented. (C.E.S.)

40280 DO NEUTRINOS INTERACT BETWEEN THEMSELVES? Z. Bialynicka-Birula (Inst. of Physics, Warsaw). Nuovo Cimento (10), 33: 1484-7(Sept. 1, 1964).

The question of whether present experimental data allow for the existence of interactions between neutrinos much stronger than their weak interactions. It is found that such interactions even if they were 10^6 times stronger than weak interactions could not be detected with the present experimental accuracy. The existence of Fermi-type interactions between various neutrinos is assumed. The influence of such an interaction on the properties of several processes is investigated. The meson (μ) decay, meson ($\pi^\pm$) and ($K^\pm$) decay into a meson (μ) and three neutrinos, and the production of electrons by meson (μ)-associated neutrinos on nucleons are considered. The comparison of the theoretical calculations with experimental results gives the upper limit for the coupling constant in the assumed neutrino interaction. (C.E.S.)

40281 POSITRON ANNIHILATION IN Si SINGLE CRYSTALS. A. Agodi, I. F. Quercia, and E. Turrisi (Università, Catania, Italy). Nuovo Cimento (10), 33: 1488-9(Sept. 1, 1964).

An experiment designed to investigate the dependence of the photon angular correlation, i.e., of the electron-positron wave function on the crystal symmetry around the ⟨111⟩ axis of a Si p-type single crystal is described. The results are reported mainly to point out a new possibility of defining experimentally the symmetry elements of the squared modulus of the Fourier transform of the positron-electron wave function. (C.E.S.)

40282 REMARKS ON THE MASSES OF BARYON AND MESON RESONANCES. H. Harari (Soreq Research Establishment, Nahal Soreq, Yavne, Israel). Nuovo Cimento (10), 33: 1490-2(Sept. 1, 1964).

A composite particle model is suggested for the baryon and meson resonances, which enables one to calculate the masses using SU_3-invariant interaction without assuming any explicit dynamical description. (C.E.S.)

40283 IX CONFERENCE ON HIGH ENERGY PHYSICS, KRAKOW, 24-29 SEPTEMBER 1963. Nukleonika, 9: 73-231(1964).

Twenty-eight papers were presented. Separate abstracts were prepared for 22. Six papers were previously abstracted in NSA; see abstracts 17: 36656, 41935, 41936; 18: 18641, 30517, and 34520. (M.J.T.)

For abstracts of individual papers see: 40181, 40284, 40285, 40286, 40287, 40288, 40289, 40290, 40291, 40292, 40293, 40294, 40295, 40296, 40297, 40298, 40546, 40547, 40548, 40549, 40550, and 40551.

40284 ELASTIC SCATTERING OF 4 Gev/c π^--MESONS ON PROTONS. Z. F. Korbel, M. G. Shafronova, A. I. Zlateva, P. K. Markov, T. S. Todorov, H. M. Chernev, N. Dolhazhav, and D. Tuvdendorzh. Nukleonika, 9: 113-18 (1964). (In Russian)

Diffraction scattering of high-energy particles was investigated in connection with the possibility of an interpretation by Regge poles. Three photoemulsion chambers were irradiated with a 4 Bev/c π^--meson beam. The energy spectrum of the primary pions was determined according to the pion scattering angle and the path length of the recoil proton. Differential cross sections of elastic π^--p scattering are given for 200 events at 3 to 15° and for proton momenta between 2.6 and 5.4 Bev/c and compared with Coulomb-scattering interference curves and previous data for 10 Bev/c pions. The data were approximated by a function of the form $d\sigma/d(-t) = Ke^{At}$, where t is momentum transfer. (M.J.T.)

40285 π^+p INTERACTIONS AT 4.0 Gev/c. Nukleonika, 9: 119(1964).

Preliminary results are presented of a study of π^+p interactions at 4.0 Bev/c. Cross sections for all two-prong and four-prong channels are presented. Detailed discussion is limited to inelastic interactions in which not more than one neutral particle is produced. Cross sections for ρ, ω, η, and N^* production in the various channels are given. In the case of the reaction $\pi^+p \rightarrow p\pi^+\pi^0$ there is some suggestion of destructive interference between N^* and ρ^+ production. No positive evidence for a T = 5/2 isobar is found with the present data. (auth)

40286 TWO PRONG INELASTIC INTERACTIONS OF 3.0 Gev/c ANTIPROTONS IN HYDROGEN WITH ONE PION PRODUCTION. T. Hofmokl (Univ. of Warsaw). Nukleonika, 9: 121-4(1964).

Interactions of a separated 3 Bev/c antiproton beam with hydrogen in the 81-cm Saclay HBC were observed. 4400 photographs were scanned twice; 1055 two-prong star events were found; 187 of these were inelastic events of the type $\bar{p}p \rightarrow N\bar{N}\pi$. Cross sections were calculated for the production of ($p\bar{p}\pi^0$), ($\pi^+\bar{p}n$), and ($p\pi^-\bar{n}$). Effective masses were computed and are shown on a Dalitz plot. The effective mass distributions are plotted. The formation of the $^3/_2$, $^3/_2$ isobar is clearly indicated. The Treiman-Yang test was performed for comparison with the one-pion exchange model; results agree within the statistical error. (M.J.T.)

40287 π^--NUCLEON INTERACTIONS AT 7.5 Gev. G. Bohm, J. Klabuhn, U. Krecker, K. Lanius, and F. Wysotzki (Forschungsstelle fur Physik hofer Energien, Deutsche Akademie der Wissenschaften, Berlin). Nukleonika, 9: 125-31(1964).

Data on 460 events from π^--nucleon interactions in emulsions at 7.5 Bev are presented. Of 605 measured secondary tracks, 515 were identified as pions, 82 as protons, and 8 as strange particles. Observed frequencies of secondary particles and mean prong numbers are listed. Blob density versus $p\beta c$ is plotted. Distributions are presented of the proton momenta in the lab system and cms, inelasticities, pion momenta in the cms, pion transverse momenta, and pion production and scattering angles in the cms. Mean values of pion and proton momenta as a function of prong number are listed. It was shown that at least two mechanisms, peripheral and central, operate in the interactions. (M.J.T.)

40288 INTERACTIONS OF π^--MESONS WITH NUCLEONS WITH SLOW RECOIL PROTON. I. Patoeka and I. Vrana. Nukleonika, 9: 133-4(1964). (In Russian)

Peripheral interactions of pions with nucleons, which can be explained by the one-particle exchange model, are studied. Of 6000 compressions of a propane bubble chamber exposed to a 6.8 Bev/c pion beam, 280 events were chosen in which a single slow proton with momentum between 200 and 800 Mev/c was emitted. Asymmetry coefficients and average transverse momenta are given for various multiplicities for elastic and inelastic interactions. Effective mass distributions are presented. (M.J.T.)

40289 PRELIMINARY RESULTS CONCERNING THE PRODUCTION OF π^0-MESONS IN π^--NUCLEON INTERACTIONS. I. Klugov. Nukleonika, 9: 135-9(1964). (In Russian)

A propane bubble chamber was exposed to a negative pion beam with momenta 6.8 and 7.5 Bev/c, in a magnetic field of 13,700 Oe. Criteria for the selection of interactions producing neutral pions, which decay into two photons, are discussed. Calculated distributions of the statistical weight of the electron-positron pairs produced by the photons are given. Distributions of transverse momenta, momenta, and emission angles are presented for secondary π^-, π^+, and π^0 mesons. (M.J.T.)

40290 QUASI-ELASTIC π^--N INTERACTIONS AT 9 Gev. I. M. Gramenitskii, T. Kanarek, L. S. Ohrimenko, A. Prokesh, and B. Slowinski. Nukleonika, 9: 147-54(1964). (In Russian)

The interactions on quasifree nucleons — $\pi^- + p \rightarrow \pi^- + p$, $\pi^- + n \rightarrow \pi^- + n$, and $\pi^- + p \rightarrow \pi^0 + n$— were studied in a xenon bubble chamber irradiated by a 9 Bev/c π^- meson beam. Selection criteria for the interactions are discussed. The dependence of the angles of flight of the secondary particles on the magnitude and direction of the Fermi momentum is considered. Effective mass distributions for the two photons from the decaying π^0 mesons are given. Results are correlated with previous experimental results for π^- beams of 7 to 10 Bev/c. (M.J.T.)

40291 ON THE POSSIBILITY OF Λ HYPERON CREATION THROUGH ISOBARS IN π^--p INTERACTIONS AT 7-8 Gev. V. F. Vishnevskii, Yuan-tsai Du, V. I. Moroz, A. V. Nikitin, Yu. A. Troyan, Shao-chun Chien, Wen-oi Chan, B. A. Shahbazyan, and Wu-kuang Yen. Nukleonika, 9: 161-75(1964). (In Russian)

Data from previous works are used to investigate the possibility of Λ creation through isobars in π^--p interactions at 7 to 8 Bev. A kinematic analysis is made of angular and momentum distributions, transferred three- and four-momentum, and energy transfer of the Λ hyperon, formed through isobars $N_{\frac{3}{2}}^*$ and Y_1^*, in the π^--p cms. Coefficients of elastic interaction and masses of the aggregate of remaining particles, B, are calculated in the interaction $\pi^- + p \rightarrow A + B$, where A is an isobar, decaying into Λ and π or K. Kinematic dependences of momentum on emission angle are presented for various cases of decay into Λ and K. (M.J.T.)

40292 ON THE POSSIBILITY OF ESTABLISHING OF ISOBAR STATE SYSTEMS AND THEIR DECAY MODES. V. F. Vishnevskii, Yuan-tsai Du, V. I. Moroz, A. V. Nikitin, Yu. A. Troyan, Shao-chun Chien, Wen-oi Chan, B. A. Shahbazyan, and Wu-kuang Yen. Nukleonika, 9: 177-8 (1964). (In Russian)

Baryon resonances are treated as excited states— isobars— of nucleons and hyperons with determined values of effective mass, isospin, spin, parity, etc. They are divided into three groups according to strangeness or hypercharge. Allowed transitions within the groups, via mesons with strangeness zero, and between them, via strangeness ±1 mesons, are displayed. (M.J.T.)

40293 SIX-PRONG INTERACTIONS OF 10 Gev/c NEGATIVE PIONS IN HYDROGEN. M. Bardadin (Univ. of Warsaw), L. Michejda, S. Otwinowski, and R. Sosnowski. Nukleonika, 9: 179-87(1964).

Forty thousand films from the 81-cm Saclay HBC exposed to a 9.9 Bev/c π^- beam were scanned twice for all interactions; number of events and cross sections for interactions with 0 to 10 prongs are given. Of 1586 six-prong events, 726 were analyzed. The reaction $\pi^- + p \rightarrow 3\pi^- + 2\pi^+ + p$ was separated; the proton angular and momentum distributions, the π^+ and π^- angular distributions, mean momentum angular dependence and momentum flux angular distributions, and the p-π^+ and p-π^- mass distributions are presented. For all 726 measured events, the π^+ and π^- angular distributions, the dependence of mean transverse momentum on longitudinal cms momentum, and the $\pi^+\pi^-$ mass distribution compared with the $(\pi^+\pi^+) + (\pi^-\pi^-)$ distribution are presented. (M.J.T.)

40294 THE STRANGE PARTICLES PRODUCTION BY 10 Gev/c π^- ON PROTONS. A. Bigi, S. Brandt, A. Cooper, A. de Marco, Ch. Peyrou, R. Sosnowski, and A. Wroblewski (CERN, Geneva; Inst. for Nuclear Research, Warsaw; and Univ. of Warsaw). Nukleonika, 9: 199(1964).

The analysis of the production processes of hyperons and kaons by 10 Bev/c π^- in the 81 cm Saclay HBC is presented. The cms distributions for Σ^+ and Σ^- hyperons are compared with those of Λ^0 hyperons and protons. The dependence of the total cms momentum of secondaries on their mass is discussed. (auth)

40295 THE ANALYSIS OF THE INTERACTIONS OF 10 Gev/c π^- ON PROTONS WITH ONE K^0-MESON AND A PROTON IDENTIFIED. S. Brandt and A. Wróblewski (CERN, Geneva and Univ. of Warsaw). Nukleonika, 9: 201 (1964).

The production of resonances in π^--p interactions, with the proton identified by ionization and a single K^0 recorded in a chamber, is discussed. The cms distribution of the protons is presented. (auth)

40296 INTERACTIONS OF 16 Gev/c π^--MESONS IN HYDROGEN WITH THE PRODUCTION OF STRANGE PARTICLES. J. Bartke. Nukleonika, 9: 203(1964). (In Russian)

An analysis was made of 152 interactions in a hydrogen bubble chamber. Data were obtained on the average number of generated π mesons and their angular and momentum distributions. An experiment was performed to describe the cases of simultaneous particle production by a peripheral diagram. (tr-auth)

40297 INELASTIC TWO-PRONG INTERACTIONS AT 17.2 Gev IN EMULSION. G. Bozoki, E. Fenyves, E. Gombosi, and E. Nagy (Central Research Inst. for Physics, Budapest). Nukleonika, 9: 211-16(1964).

The inelastic two-prong π^--p interactions at 17.2 Bev in an emulsion were investigated to study the quasi-elastic diffraction character of inelastic processes at small multiplicities. Seventy two-prong inelastic π^--p interactions were found and measured. Particle mass and momentum were found from measurements of blob density, multiple scattering, and range. Angular and momentum distributions of pions and protons in the cms are presented. The four-momentum transfer distribution of π^-, in the reaction $\pi^- + p \rightarrow \pi^- + p + k\pi^0$, k = 1,2, . . ., and of pions having

the minimum four-momentum transfer, in the reaction $\pi^- + p \rightarrow \pi^- + \pi^+ + n + k'\pi^0$, $k' = 0,1,\ldots$, were calculated. The quasi-elastic diffraction character of inelastic interactions at small multiplicities is unambiguously indicated; several preliminary models are suggested to explain experimental results. (M.J.T.)

40298 MULTIPLE PRODUCTION IN π^--p COLLISIONS AT 4.5 Gev, ACCORDING TO THE STATISTICAL THEORY OF FERMI-KOBA. M. Majewski. Nukleonika, 9: 229-31 (1964). (In Russian)

The Fermi-Koba statistical theory for π-N inelastic collisions, which allows the experimentally found anisotropy and asymmetry of the angular distributions of the emitted particles to be obtained, is considered. An interaction model is taken in which, after collision, the system consists of a baryon (nucleon or $^3/_2$, $^3/_2$ isobar) and a π-meson cloud. The interaction probability is calculated as a function of the number of tracks in the star and compared with other theoretical and experimental results. The computed angular distribution of the pions in the pion-cloud system is presented. (M.J.T.)

40299 THE PRINCIPAL AXIS OF JETS—AN ATTEMPT TO ANALYSE HIGH-ENERGY COLLISIONS AS TWO-BODY PROCESSES. S. Brandt, Ch. Peyrou, R. Sosnowski, and A. Wroblewski (CERN, Geneva). Phys. Letters, 12: 57-61(Sept. 1, 1964).

A method for analyzing jets in terms of a two-intermediate-body model is described, and some results obtained by applying the procedure to events $\pi^- + p \rightarrow K^0 + \Lambda^0 + x\pi$ at 10 Bev/c are presented. (D.C.W.)

40300 SOME CONSEQUENCES OF 'REPULSIVE' MESON-MESON FORCE. A. N. Mitra (Univ. of Delhi). Phys. Letters, 12: 61-2(Sept. 1, 1964).

The predictions of a model in which the effective π-π interaction is repulsive at low energy, changing to attraction only at sufficiently high energy, are discussed in relation to experimental observations. (D.C.W.)

40301 ABSORPTIVE DAMPING IN n-p CHARGE-EXCHANGE. G. A. Ringland (Univ. of Edinburgh) and R. J. N. Phillips. Phys. Letters, 12: 62-4(Sept. 1, 1964).

The angular distribution for n-p scattering was calculated for both one-pion exchange and rho-meson exchange, with and without absorption derived from p-p diffraction scattering. (D.C.W.)

40302 EVIDENCE FOR A ($K\pi\pi$) RESONANCE WITH $T_z = \pm^3/_2$ AT 1270 Mev. R. Boeck (CERN, Geneva), B. R. French, J. B. Kinson, V. Simak, J. Badier, M. Bazin, B. Equer, A. Rouge, and P. Grieve. Phys. Letters, 12: 65-7(Sept. 1, 1964).

Analysis of $\bar{p} + p \rightarrow K_1^0 + K^\pm + 4\pi$ events observed in a hydrogen bubble chamber exposed to a 3-Bev/c antiproton beam revealed a peak in the ($K\pi\pi$) mass distribution, the mass and width of which were determined to be around 1270 and 60 Mev, respectively. Two possible interpretations of the peak are considered. (D.C.W.)

40303 K_2^0 DECAY SPECTRA. R. K. Adair (Yale Univ., New Haven) and L. B. Leipuner. Phys. Letters, 12: 67-9 (Sept. 1, 1964). (BNL-8254)

The decays of 1.05-Bev/c mesons (K_2^0) were observed in a liquid hydrogen bubble chamber. Analysis of 524 events gave a value of 0.81 ± 0.19 for the ratio of the transition rates for the processes $K_2^0 \rightarrow \mu + \pi + \nu$ and $K_2^0 \rightarrow e + \pi + \nu$. The ratio of the rate for $K_2^0 \rightarrow \pi^0 + \pi^- + \pi^+$ to that for all charged decays was determined to be 0.151 ± 0.020. The energy distribution parameter was also obtained. (D.C.W.)

40304 ON THE UPPER LIMIT OF THE DECAY $\omega^0 \rightarrow e + e^-$. A. Bezaguet (Ecole Polytechnique, Paris), U. Nguyen-Khac, A. Rousset, A. Haatuft, A. Halsteinlid, B. S. Luetchford, and F. R. Stannard. Phys. Letters, 12: 70-1(Sept. 1, 1964).

A possible $\omega^0 \rightarrow e^+ + e^-$ event was observed in a C_2F_5Cl bubble chamber exposed to a 1.47-Bev/c meson(K^-) beam. An upper limit of 2.8×10^{-3} was derived for the branching ratio $\omega^0 \rightarrow e^+ + e^-/\omega^0 \rightarrow \pi^+ + \pi^- + \pi^0$. (D.C.W.)

40305 A SEARCH FOR THE TWO-BODY RADIATIVE DECAY OF Σ^+. R. Carrara, M. Cresti, A. Grigoletto, S. Limentani, L. Peruzzo, R. Santangelo, and R. B. Willmann (Universitâ, Padua and Istituto Nazionale di Fisica Nucleare, Padua). Phys. Letters, 12: 72-4(Sept. 1, 1964).

The decay of hyperons (Σ^+) produced in the interaction $K^- + p \rightarrow \Sigma^+ + \pi^-$ of meson (K^-) coming to rest in a liquid hydrogen bubble chamber were studied. One $\Sigma^+ \rightarrow p + \gamma$ was identified. The branching ratio $\Sigma^+ \rightarrow p + \gamma/\Sigma^+ \rightarrow p + \pi^0$ was determined to be 0.68×10^{-3}. The proton momentum in the Σ^+ rest frame was calculated to be 223.5 ± 8.0 Mev/c. (D.C.W.)

40306 DIRECT MEASUREMENT OF THE MAGNETIC FORM FACTOR OF THE PROTON. D. Frerejacque, D. Benaksas, and D. Drickey (Faculte des Sciences, Orsay, France). Phys. Letters, 12: 74-5(Sept. 1, 1964).

The magnetic form factor of the proton was measured directly by determining absolute values of the differential cross sections for electron-proton elastic scattering by observing the recoil proton at 0°. (D.C.W.)

40307 PION-NUCLEON PHASE SHIFTS AND RESONANCES. P. Auvil (Imperial Coll. of Science and Tech., London), C. Lovelace, A. Donnachie, and A. T. Lea. Phys. Letters, 12: 76-80(Sept. 1, 1964).

A phase shift analysis of π-p scattering at 300 to 700 Mev was performed. A phase set in excellent agreement with practically all the experiments and with predictions from partial-wave dispersion relations was obtained. The D_{13} resonance appeared at 620 Mev, but with a width of only 90 Mev. The Ball-Frazer mechanism in S_{11} was confirmed, and peculiarities were noted in the P_{11} resonance. (D.C.W.)

40308 RELATIVISTIC CALCULATION OF THE DEUTERON ELECTROMAGNETIC FORM FACTOR. [PART] II. Franz Gross (Cornell Univ., Ithaca, N. Y.). Phys. Rev., 136: B140-61(Oct. 12, 1964).

The deuteron form factor is calculated in a one-pion-exchange (OPE) approximation using single-variable unsubtracted dispersion relations in the squared-momentum-transfer variable. As a first step, the imaginary parts of the form factors are presented in terms of the four invariants of the deuteron-nucleon (d–N) vertex. The resulting equations are compared in detail with similar expressions obtained from the Jankus potential theory, and a clear understanding of the precise way in which the d–N invariants play the role of the deuteron wave function emerges, enabling us to obtain relativistic wave functions. This comparison also shows the presence of new relativistic terms not included in the Jankus results (in particular, a new term appears in the magnetic moment). Then, the imaginary parts of the d–N vertex invariants are calculated numerically. In this calculation the OPE contribution in its anomalous region is calculated exactly, while the contributions above the normal threshold are obtained by an educated guess based on sum rules which the invariants are assumed to satisfy. Finally, using these results, the form factors are calculated numerically. With the assumption of

unsubtracted dispersion relations, it is necessary to assume only the charge and mass of the deuteron, and the pion-nucleon coupling constant, in order to completely determine the form factors. The numerical results for the magnetic and quadrupole moments agree with experiment to within 2%; the D-state probability if 5.5% but is not very reliably determined, and the other results, while less good, are still quite reasonable. (auth)

40309 RELATION BETWEEN MASSES OF PSEUDOSCALAR OCTET AND VECTOR OCTET. José R. Fulco and David Y. Wong (Univ. of California, San Diego, La Jolla). Phys. Rev., 136: B198-200(Oct. 12, 1964).

The effect of the splitting of a pseudoscalar octet on the splitting of a vector octet is investigated using a simple effective-range formula for the coupling of a vector to two pseudoscalars. Taking the observed masses of the pseudoscalar octet to be $\eta(548)$, K(496), and $\pi(140)$, it is found that the mass differences among the members of the vector octet φ, K*, and ρ give the order $\varphi > K^* > \rho$. The magnitude of the calculated splitting is approximately twice the observed values. It is also shown that to first order in the mass splitting, if the pseudoscalar octet satisfies the Gell-Mann-Okubo mass formula, then the vector octet also satisfies the GMO formula. Furthermore, a deviation of the pseudoscalar masses from the GMO formula implies a somewhat larger deviation for the vector masses with an opposite sign. This result is in qualitative agreement with experimental values. (auth)

40310 PHOTOPRODUCTION OF CHARGED MESONS FROM FREE NUCLEONS FOR BOMBARDING GAMMA-RAY ENERGIES NEAR 275 Mev. D. Garelick and G. Cooperstein (Massachusetts Inst. of Tech., Cambridge). Phys. Rev., 136: B201-13(Oct. 12, 1964). (TID-20518)

The differential cross section for the photoproduction of a π^- meson from the neutron bound in the deuteron was measured for pion laboratory angles of 76, 96, and 118° at incident gamma-ray energies in the region of 275 Mev. The π^- meson and the high-energy proton were detected. The pion momentum and angle were measured by sets of spark chambers situated in front of and behind a magnetic field. The proton angle and range were also measured with spark chambers. To calculate free neutron cross sections from the data, a modified version of the extrapolation method suggested by Chew and Low was used. By observing the π^+ only, the differential cross section for π^+ photoproduction from hydrogen also was measured. The differential cross section for photoproduction of a π^- meson from a free neutron and the differential cross section for photoproduction of a π^+ meson from hydrogen are given. The results disagree with the dispersion theory predictions of Chew, Goldberger, Low, and Nambu. They also disagree with McKinley's dispersion theory calculations which include a bipion or ρ-meson term in the production amplitudes. (auth)

40311 TEST FOR THE EXISTENCE OF THE NEUTRAL VECTOR BOSON OF WEAK INTERACTIONS. Howard R. Reiss (Naval Ordnance Lab., Silver Spring, Md.) and Vladimir Wataghin. Phys. Rev., 136: B214-16(Oct. 12, 1964).

An experiment is proposed to detect the possible existence of a neutral vector boson (W_0) weakly coupled to leptons. It is shown that this boson would exhibit itself as a resonance in high-energy e^+-e^- scattering into two-lepton final states. This resonance makes the boson contribution comparable to and distinguishable from the electromagnetic contribution to the e^+-e^- scattering process. Observation of the resonance would permit a direct measurement of the lepton-W_0 coupling constant and provide also a test of the hypothesis of universality of the weak interactions. The experiment should become possible shortly when high-energy colliding beams of electrons and positrons are available. (auth)

40312 DYNAMICS OF THE $d_{\frac{3}{2}}$ UNITARY MULTIPLETS. J. J. Brehm (Northwestern Univ., Evanston, Ill.). Phys. Rev., 136: B216-20(Oct. 12, 1964).

A dynamical model of pseudoscalar meson-baryon scattering in the $J^P = \frac{3}{2}^-$ state is proposed to support the conjecture of Glashow and Rosenfeld that the N** (1512) resonance is a member of a unitary-symmetry octet. The dynamical mechanism analyzed is based on the Cook-Lee model of the higher pion-nucleon resonances. It is shown that the coupling to inelastic vector meson-baryon states in a generalized two-channel formalism yields an octet of $d_{\frac{3}{2}}$ resonances and a unitary singlet as well. The baryon, pseudoscalar-meson, and vector-meson octets are each assumed degenerate, so that the Cook-Lee model is immediately adaptable to an analysis of resonant unitary multiplets as a function of f, the Yukawa mixing parameter. It is found that, for f = 0.326, the attraction is slightly greater for the octet than for the singlet. The 2×2 octet amplitude is diagonalized by a rotation through an angle $\theta^* = 45°$; the Yukawa mixing parameter is $f^* = 0.428$. The $N^{**}N\pi$ coupling constant is computed to be $g^{*2}/(4\pi) = 0.150\ m_\pi^{-2}$, which may be compared with the observed N** width. (auth)

40313 UNITARY SYMMETRY AND THE $K \to 2\pi$ DECAY. Kiyomi Itabashi (Argonne National Lab., Ill.). Phys. Rev., 136: B221-2(Oct. 12, 1964).

It is shown that all the $K \to 2\pi$ decays are forbidden in the limit of complete SU_3 symmetry of strong interactions, provided only (a) that both K and π mesons belong to the same octet and (b) that the nonleptonic decay interactions belong to the CP-invariant representation (the irreducible representation whose Y = Q = 0 members are CP-invariant). This is more general than the conclusion of Cabibbo and Gell-Mann. In their proof, the nonleptonic decay lagrangian is assumed to belong to a CP-invariant octet. This result suggests that the observed large decay rate of $K_1^0 \to 2\pi$ decay is due to the symmetry-breaking interactions and its large Q value. A brief comment is given concerning the $(K_1^0 \to 2\pi) - (K^+ \to 2\pi)$ puzzle in the $\Delta I = \frac{1}{2}$ rule. It is shown that, if one assumes the $\Delta I = \frac{1}{2}$ rule in addition to the above hypothesis (b), the $K^\pm \to 2\pi$ decay can occur only through the electromagnetic corrections and its effective decay lagrangian should belong to the representations 10 and $\overline{10}$. (auth)

40314 DEPARTURES FROM THE EIGHTFOLD WAY. II. BARYON ELECTROMAGNETIC MASSES. Sidney Coleman (Harvard Univ., Cambridge, Mass.) and Howard J. Schnitzer. Phys. Rev., 136: B223-6(Oct. 12, 1964).

The leading nontadpole contributions to the electromagnetic mass splittings of the baryons are calculated. Best fits to experiment are used for the nucleon form factors; the strange baryon form factors are obtained from these by unitary symmetry. Account is taken of the breakdown of unitary symmetry by using experimental masses in intermediate states and by including the effects of $\theta-\omega$ mixing. These calculations and the assumption of tadpole dominance are used to fit the six mass splittings of baryons and pseudoscalar mesons with one free parameter. All of the splittings are in good agreement with experiment except for the kaon splitting, which has the right sign but only $\frac{2}{3}$ of the proper magnitude. (auth)

40315 THRESHOLD REGGE POLES AND THE EFFECTIVE-RANGE EXPANSION. Bipin R. Desai and Bunji

Sakita (Univ. of Wisconsin, Madison). Phys. Rev., 136: B226-7(Oct. 12, 1964). (TID-20668)

It is shown, without any reference to potentials, that an infinite number of Regge poles approach $l = -\frac{1}{2}$ in the limit of zero energy. Unitarity and the assumption of a Sommerfeld-Watson transform play the crucial role. As a by-product an improved effective-range expansion is obtained. (auth)

40316 DYNAMICAL BASIS OF THE SUM RULE $2\Xi^- = \Lambda^- + \sqrt{3}\Sigma_0^+$. Benjamin W. Lee and Arthur R. Swift (Univ. of Pennsylvania, Philadelphia). Phys. Rev., 136: B228-30 (Oct. 12, 1964).

The amplitudes for the nonleptonic decay of hyperons are explained by a simple dynamical model in the framework of SU(3) symmetry. The parity-conserving amplitudes are described by the Feldman-Matthews-Salam model, while the parity-violating amplitudes are given by the dominance of the $K^* \to \pi$ diagram. An effective weak hamiltonian is used that transforms like λ_6 under SU(3). The model predicts the sum rule $2\Xi^- = \Lambda^- + \sqrt{3}\Sigma_0^+$ for each set of amplitudes; in addition, all other experimental data on the amplitudes can be fitted by the model. These results are obtained without explicitly invoking RP invariance. (auth)

40317 SYMMETRIZATION POSTULATE AND ITS EXPERIMENTAL FOUNDATION. A. M. L. Messiah (Centre d'Études Nucléaires de Saclay, Gif-sur-Yvette, France) and O. W. Greenberg. Phys. Rev., 136: B248-67(Oct. 12, 1964).

The symmetrization postulate (SP) that states of more than one identical particle are either symmetric or antisymmetric under permutations is studied from the theoretical and experimental points of view. The theoretical analysis is carried out within the framework of particle quantum mechanics; the field-theory approach to identical particles using Bose, Fermi, para-Bose and para-Fermi quantization is not considered. Particles not obeying SP can be accommodated in quantum mechanics, provided some modifications are made in the usual quantum-mechanical formalism. The main modification is to replace the usual ray by a many-dimensional generalized ray as the representative of a physical state. The properties of one-body measurements of systems having several identical particles are discussed, and the unobservability in such measurements of interferences between states having different irreducible permutation symmetries is pointed out. The condition of indistinguishability of identical particles is formulated precisely, and is analyzed both for interactions which conserve particle number and for general interactions which do not. For such general interactions, with the additional assumptions of time-reversal invariance and of coherence of the states having given values of charge, baryon number, and lepton number, it is shown that there is an absolute selection rule forbidding transitions between states F^X which contain any number of particles of species which obey SP but at most one particle of a species not obeying SP, and states which violate SP. Since only states in F^X are now available as initial states of experiments, this selection rule forbids production of SP-violating states in any experiment which is feasible at present. Because of this, presently proposed experimental tests of SP are in fact tests of the quantum-mechanical description of identical particles together with time-reversal invariance and coherence of states in a given superselecting sector. The inclusion of internal variables, such as isospin, for particles violating SP is discussed. A comprehensive discussion is given of direct experimental tests of the SP selection rules. Such tests are more difficult to perform than appears at first sight, because in many cases the indistinguishability of identical particles or the conservation laws already imply the consequences of SP. Criteria for valid tests of SP are given. Several different types of tests are described, with illustrative examples of each. A survey is given of the direct experimental evidence for SP for the various particles. The Fermi character of electrons and positrons and of nucleons is accepted, as is the Bose character of photons. There is good evidence for the Bose nature of pions, especially from the absence of 2π decay of K_2^0. There is no direct evidence for the statistics of K, Λ, Σ, Ξ, or μ. Feasible tests are proposed for the statistics of K and of those hyperons which have an asymmetric decay; but no such tests were found for the other hyperons or for μ. (auth)

40318 AXIAL-VECTOR CURRENT IN BROKEN UNITARY SYMMETRY. Riazuddin (Univ. of Rochester, N. Y.). Phys. Rev., 136: B268-72(Oct. 12, 1964). (UR-875-34)

By using Goldberger-Treiman-type relations and the octet version of broken unitary symmetry with the symmetry-breaking interaction behaving as T_3^3 or λ_8, Cabibbo's assumptions regarding the axial-vector interaction for leptonic decays of strongly interacting particles are justified. (auth)

40319 SELECTION RULES AND SOME RELATIONS IN W_3 SYMMETRY. Mahiko Suzuki (Tokyo Univ.). Phys. Rev., 136: B272-4(Oct. 12, 1964).

In the limit of W_3 symmetry proposed by Schwinger, selection rules and some relations among partial cross sections are derived through elementary calculations. One of the main results is that $\pi + N \to \Sigma + n$ pseudoscalar mesons, $\bar{K} + N \to \Sigma + n$ pseudoscalar mesons, and $\bar{K} + N \to \Xi + n$ pseudoscalar mesons are forbidden as well as their crossed reactions. Many of the selection rules and the relations derived here are badly violated at least in low-energy region. However, they should be tested with experimental data at much higher energies than those available at present. (auth)

40320 EUCLIDEAN APPROACH TO THE BETHE-SALPETER EQUATION FOR SCATTERING. George Tiktopoulos (Princeton Univ., N. J.). Phys. Rev., 136: B275-80(Oct. 12, 1964).

It is shown that the mass-shell scattering amplitude in the physical scattering region (two-particle branch cut) can be directly obtained from the resolvent of the Bethe-Salpeter kernel transformed according to Wick (rotation of the energy integration paths to the imaginary axis). As an illustration and under the assumption that the kernel is approximated by any finite set of irreducible graphs, the scattering amplitude in ϕ^3 theory is given in terms of a Fredholm formula whose convergence is explicitly demonstrated. (auth)

40321 RESONANCE MODELS FOR NUCLEON ELECTROMAGNETIC STRUCTURE. V. Barger and R. Carhart (Univ. of Wisconsin, Madison). Phys. Rev., 136: B281-5 (Oct. 12, 1964). (COO-30-92)

Theoretical restrictions that must be imposed on models of nucleon electromagnetic structure are derived. The equality of electric and magnetic form factors at the threshold for nucleon-antinucleon annihilation ($q^2 = -4M^2$) is established from the proper momentum dependence of the s- and d-wave matrix elements of the electromagnetic current density. The role of this equality in approximate theoretical treatments of G_E and G_M is discussed. Certain general implications of recent elastic electron-proton scattering data are interpreted as additional constraints to be imposed on resonance models which have no core contributions. One such proposed four-pole model involving the [ω,ϕ,ρ,B] vec-

tor resonances is found to be inconsistent with certain of these restrictions. (auth)

40322 PARTICLE MIXING AND RENORMALIZATION. S. A. Dunne (Imperial Coll. of Science and Tech., London). Phys. Rev., 136: B285-8(Oct. 12, 1964).

The field theory of neutral vector particles interacting with conserved currents is investigated as an example of particle mixing. It is shown that a generalization of conventional renormalization is necessary when mixing occurs, and that the observable masses and coupling constants are sufficient to determine transition amplitudes, without recourse to mixing parameters. The universality of electric charge renormalization is not changed when photon–vector-meson mixing is possible. (auth)

40323 THREE-PARTICLE BARYON RESONANCES IN UNITARY SYMMETRY. H. Harari (Israel Atomic Energy Commission, Yavne) and H. J. Lipkin. Phys. Rev. Letters, 13: 345-8(Sept. 7, 1964).

The possible resonances or bound states of a baryon and two mesons that can only be classified in supermultiplets larger than those appearing in the product of two octets are discussed. Classification in the 35-dimensional supermultiplet is particularly considered, with a brief mention of the 64-dimensional classification. (D.C.W.)

40324 2π DECAY OF THE K_2^0 MESON. J. S. Bell and J. K. Perring (Stanford Univ., Calif.). Phys. Rev. Letters, 13: 348-9(Sept. 7, 1964).

The possibility that the small violation of CP invariance previously observed in meson (K_2^0) decay is a local effect due to the local preponderance of matter over antimatter was considered, using a model with a vector field analogous to the electromagnetic field, but coupled to hypercharge rather than charge. A weak local violation of Lorentz invariance as well as CP invariance was obtained. The branching ratio for anomalous decay varies with the square of the particle energy. (D.C.W.)

40325 MESON EXCHANGE EFFECTS IN ELASTIC e-d SCATTERING. R. J. Adler and S. D. Drell (Stanford Univ., Calif.). Phys. Rev. Letters, 13: 349-52(Sept. 7, 1964).

The contribution of the three-pion-exchange current to the deuteron magnetic form factor was calculated, giving the correction to the deuteron magnetic moment. (D.C.W.)

40326 ELECTROMAGNETIC FORM FACTORS OF THE DEUTERON. D. Benaksas, D. Drickey, and D. Frerejacque (Ecole Normale Superieure, Orsay, France). Phys. Rev. Letters, 13: 353-5(Sept. 7, 1964).

The electric and magnetic elastic scattering of electrons from deuterons at $q^2 = 3$, 4, and 5 F^{-2} was measured by observing the momentum-analyzed recoil deuteron. The ratio of deuteron and proton scattering cross sections was measured at a laboratory angle of 45°; analysis of the data using the Hamada deuteron form factor gave the electric form factor of the neutron. The magnetic form factor of the deuteron was measured directly at 0°, and the magnetic form factor of the neutron was obtained by analysis. (D.C.W.)

40327 BROKEN SYMMETRIES AND WEAK INTERACTIONS. Julian Schwinger (Harvard Univ., Cambridge, Mass.). Phys. Rev. Letters, 13: 355-8(Sept. 7, 1964).

The violation of SU(3) and W_3 symmetry in pion decays of hyperons and meson (K) was investigated, using a model in which the mass of the ninth baryon lies 2.34 Bev below the nucleon mass. (D.C.W.)

40328 EMPIRICAL SYSTEMATICS OF THE STRONGLY INTERACTING PARTICLES. R. M. Sternheimer (Brookhaven National Lab., Upton, N. Y.). Phys. Rev. Letters, 13: 358-60(Sept. 7, 1964). (BNL-8123)

A mass formula previously proposed for the strongly interacting particles was tested using experimental mass values, with particular attention to the meson (π) mass used in the formula. (D.C.W.)

40329 PHENOMENOLOGICAL ANALYSIS OF VIOLATION OF CP INVARIANCE IN DECAY of K^0 AND $\overline{K}^0$. Tai Tsun Wu and C. N. Yang (Brookhaven National Lab., Upton, N. Y.). Phys. Rev. Letters, 13: 380-5(Sept. 21, 1964).

A phenomenological study is made of the violation of CP invariance in the decay of K^0 and $\overline{K}^0$ mesons, assuming CPT invariance, the validity of the Weisskopf–Wigner formalism, and that C, P, and T invariance hold separately for both the strong and electromagnetic interactions. Electromagnetic effects are shown to be negligible. (T.F.H.)

40330 THE SYMMETRY GROUP OF VECTOR AND AXIAL VECTOR CURRENTS. Murray Gell-Mann (California Inst. of Tech., Pasadena). Physics, 1: 63-75(July-Aug. 1964).

A theory proposed earlier of a higher broken symmetry than the eightfold way is considered. The integrals of the time components of the vector and axial vector current octets are assumed to generate, under equal time commutation, the algebra of SU(3) × SU(3). The energy density of the strong interactions is assumed to consist of a piece invariant under the algebra, a piece that violates conservation of the axial vector currents only and belongs to the representation (3, 3*) and (3*, 3), and a piece that violates the eightfold way and probably belongs to (1, 8) and (8, 1). Assuming the algebraic structure is exactly correct, there is still the question of whether one can assign particles approximately to super-supermultiplets. The pseudoscalar meson octet, together with a pseudoscalar singlet, a scalar octet, and a scalar singlet, may belong to (3, 3*) and (3*, 3). The vector meson octet, together with an axial vector octet, may belong to (1, 8) and (8, 1). The baryon octet with $J = \frac{1}{2}^+$, together with a singlet with $J = \frac{1}{2}^-$, may belong to (3, 3*) and (3*, 3), as suggested before. Several crude coupling patterns and mass rules emerge, to zeroth or first order in the symmetry violations. Some are roughly in agreement with experiment, but certain predictions, like that of the existence of a scalar octet, were not verified. Whether or not they are useful as an approximate symmetry, the equal time commutation rules fix the scale of the weak interaction matrix elements. Further rules of this kind are found to hold in certain Lagrangian field theory models and may be true in reality. In particular, an algebraic system based on SU(6) that relates quantities with different kinds of behavior under Lorentz transformations is encountered. (auth)

40331 QUANTUM THEORY OF UNSTABLE PARTICLES. J. L. Martin (National Physical Lab., Teddington, Eng.). Proc. Cambridge Phil. Soc., 60: 587-93(July 1964).

A quantum model of the scattering of a particle via absorption and re-emission at the origin is described. The model is capable of exhibiting an arbitrary number of resonances, and the associated unstable states are discussed. The emphasis is on obtaining exact results. It is found that the exponential decay law is of limited application, and that in all cases of non-zero coupling the decay goes ultimately as t^{-3}. It is pointed out that the treatment of unstable states in this type of model depends only on a knowledge of the phase shift as a function of radial momentum, and a possible phenomenological method is suggested. (auth)

40332 THE MOMENTUM SPECTRUM OF ELECTRONS FROM MUON DECAY. J. Barlow, P. S. L. Booth, L. J. Carroll, G. R. Court, J. D. Davies, D. N. Edwards, R. G. Johnson, and J. R. Wormald (Univ. of Liverpool). Proc. Phys. Soc. (London), 84: 239-44(Aug. 1964).

A magnetic spectrometer has been used to measure the momentum spectrum of electrons from the decay of positive and negative muons. For the positive particles the Michel (Proc. Phys. Soc. A, 63: 514(1950)) ρ parameter was found to be 0.661 ± 0.016 and for the negative particles 0.64 ± 0.04. (auth)

40333 INTERACTIONS OF HIGH-ENERGY MUONS. J. C. Barton (The Northern Polytechnic, London). Proc. Phys. Soc. (London), 84: 325-6(Aug. 1964).

The electromagnetic interactions of cosmic ray muons underground have been studied using a stack of large counters interleaved with lead sheets. The numbers of interactions with secondary energies from 0.2 to 100 Bev are found to be in agreement with theory over the entire energy range. (auth)

40334 ON THE STIMULATED DECAY OF HEAVY HYPERFRAGMENTS ($60 < A < 100$). SIMULATION OF NUCLEON CASCADES RESULTING FROM THE INTERACTION Λ^0N-n-N (MONTE CARLO METHOD). J. P. Lagnaux (Université, Brussels). Univ. Bruxelles, Inst. Phys., Bull., No. 12, 33p. (May 1964). (In French)

The energy spectra and emission frequencies of the nucleons emitted following proton- and neutron-stimulated decay of a hyperon (Λ^0) bound in a heavy hyperfragment were calculated for a nucleus with A = 75 by simulating the steps of the cascade stage by the Monte Carlo method. The model and details of the program used are presented, together with the results of 865 decays stimulated by both kinds of nucleons. (auth)

40335 GROUND STATE OF RAREFIED FERMI GAS CONSISTING OF RIGID SPHERES. V. N. Efimov and M. Ya. Amusya (Ioffe Inst. of Physics and Tech., Leningrad). Zh. Eksperim. i Teor. Fiz., 47: 581-92(Aug. 1964). (In Russian)

The properties of the ground states of a Fermi system are discussed. The ground state energy of a low density Fermi gas consisting of rigid spheres is calculated with an accuracy to $(p_F a)^3$ where p_F is the Fermi momentum and a is the sphere diameter. (auth)

40336 ON FORMULATION OF A THEORY OF LOW-ENERGY SCATTERING OF ELEMENTARY PARTICLES BASED ON THE SPECTRAL AND UNITARITY CONDITIONS. F. M. Kuni and V. A. Franke (Leningrad State Univ.). Zh. Eksperim. i Teor. Fiz., 47: 632-43(Aug. 1964). (In Russian)

Equations for the partial waves in the low energy region are proposed which exactly takes into account the requirement of analyticity of the scattering amplitude with respect to two variables and the unitarity conditions in all three channels below the inelastic processes thresholds. (auth)

40337 RADIATIVE CORRECTIONS TO PHOTOPRODUCTION OF ELECTRON–POSITRON PAIRS. E. G. Vekshtein (Odessa State Univ.). Zh. Eksperim. i Teor. Fiz., 47: 678-88(Aug. 1964). (In Russian)

Radiative corrections to the effective cross section for photoproduction of electron–positron pairs in a nuclear Coulomb field are calculated by the S-matrix method under the assumption that their relative magnitude (compared to the Bethe–Heitler formula) is proportional to the first power of the fine structure constant α. It is shown that if in the ultrarelativistic region $\omega \gg m$ the two particles are emitted in directions symmetric with respect to the photon momentum and at small angles with respect to it so that $0_+ = 0_- = m/\omega$ the relative correction will be proportional to $(\omega/m)^2$. The energy and angular width of this region of anomalously large radiative corrections is investigated. (auth)

40338 REGION OF APPLICABILITY OF PERTURBATION THEORY IN ELECTRODYNAMICS OF VECTOR MESONS. B. L. Ioffe and M. V. Terentev. Zh. Eksperim. i Teor. Fiz., 47: 744-9(Aug. 1964). (In Russian)

A limiting value of the energy above which perturbation theory is invalid in the electrodynamics of charged vector meson is derived by considering the vector meson vacuum polarization effect and effect of scattering of vector mesons on each other. (auth)

40339 ON THE COMPLETENESS OF THE "COMPLETE SCATTERING EXPERIMENT." N. P. Klepikov (Moscow Univ.). Zh. Eksperim. i Teor. Fiz., 47: 757-66 (Aug. 1964). (In Russian)

The complete experiment on the scattering of particles with spins (0, 0), (0, ½), and (½, ½) is consistent with only two scattering amplitudes satisfying the unitarity condition and analytical in $\cos\theta$ in some vicinity of the segment $-1 \le \cos\theta \le 1$ if this experiment is invariant with respect to the inversion of helicities, and with only one if this invariance is violated. (auth)

40340 RADIATION OF WAVE-GUIDE ACCELERATED CHARGES AND DIPOLES. M. L. Iovnovich. Zh. Tekhn. Fiz., 34: 1073-8(June 1964). (In Russian)

Expressions for the reaction strength and energy loss of radiation during the acceleration of charges and magnetic dipoles along the axis of a waveguide are obtained. (tr-auth)

40341 DYNAMICS OF CHARGED PARTICLES. Bo Lehnert. New York, John Wiley & Sons, Inc., 1964. 308p. $11.50.

The motion and confinement of charged particles in electric and magnetic fields are treated, mainly on the basis of the orbit of single particle motion. The macroscopic theory is also developed, and relativistic effects are included. (D.C.W.)

40342 STRONG, ELECTROMAGNETIC, AND WEAK INTERACTIONS. A. Zichichi, ed. New York, W. A. Benjamin, Inc., 1964. 252p. $9.00.

Twelve lectures on experimental and theoretical material pertaining to strong, electromagnetic, and weak interactions are presented. Separate abstracts are prepared for each lecture. (C.E.S.)

For abstracts of individual lectures see: 40343, 40344, 40345, 40346, 40347, 40348, 40349, 40350, 40351, 40352, 40353, and 40354.

40343 THEORETICAL INTRODUCTION. J. S. Bell (CERN, Geneva). p.1-63 of "Strong, Electromagnetic, and Weak Interactions." New York, W. A. Benjamin, Inc., 1964.

Introductory material is presented on the S-matrix, field theory, and strong, electromagnetic, and weak interactions. Free particles, energy and momentum, charge conservation, parity, time reversal, transition probabilities, the Heisenberg picture, propagators, Majorana and Dirac fields, perturbation theory, crossing symmetry, conserved coupling, conserved currents, and decay rates are discussed. (C.E.S.)

40344 TOPICS ON NON-RELATIVISTIC POTENTIAL SCATTERING. Tullio Regge (Universitâ, Turin). p.64-83 of "Strong, Electromagnetic, and Weak Interactions." New York, W. A. Benjamin, Inc., 1964.

Potential scattering, the quantum mechanical description of the motion of two bodies which interact via a spherical symmetric potential, is discussed. The case of spinless bodies is considered for simplicity. The scattering amplitude, the possibility of defining the phase shifts for non-integer complex angular momenta, asymptotic behavior, poles, the connection between properties of the pole $S(\lambda)$ as a function of λ and properties of the total amplitude as a function of the transmitted momentum, the relation between the distribution of poles and the behavior of $S(\lambda)$ for large λ, properties for Re $\lambda < 0$, properties for fixed λ and varying energy, and the pology of $S(k)$ are discussed. (C.E.S.)

40345 INELASTIC COLLISIONS AND SHADOW SCATTERING OF STRONGLY INTERACTING PARTICLES AT HIGH ENERGY. L. Van Hove (CERN, Geneva). p.84-90 of "Strong, Electromagnetic, and Weak Interactions." New York, W. A. Benjamin, Inc., 1964.

A phenomenological analysis of high-energy collisions of strongly interacting particles is considered. The analysis relies on the fact that at high energy elastic scattering seems to be, at least approximately, shadow scattering of the inelastic collisions, so that known or assumed properties of elastic (or inelastic) collisions will have mathematical consequences for inelastic (or elastic) collisions as well as for total cross sections. (C.E.S.)

40346 PARTICLES AND RESONANCES FROM THE UNITARY SYMMETRY POINT OF VIEW. H. Harari (Israel Atomic Energy Commission, Rehovoth). p.91-7 of "Strong, Electromagnetic, and Weak Interactions." New York, W. A. Benjamin, Inc., 1964.

The problem of higher symmetries of elementary particles is considered. The octet model which is based on the three-dimensional unitary group is discussed as a generalization of isotopic spin. (C.E.S.)

40347 PIONIC RESONANCES. G. Puppi (Università, Bologna). p.98-123 of "Strong, Electromagnetic, and Weak Interactions." New York, W. A. Benjamin, Inc., 1964.

Meson(π) interactions are discussed with respect to resonance production, and the properties of the mesons(η), (ρ), and (ω) are considered. (C.E.S.)

40348 WEAK INTERACTIONS. S. M. Berman (Stanford Linear Accelerator Center, Calif.). p.124-79 of "Strong, Electromagnetic, and Weak Interactions." New York, W. A. Benjamin, Inc., 1964.

Weak interactions, defined as those interactions that cause the decay of the spin $\frac{1}{2}^+$ baryons and 0^- mesons with parity violation and those interactions involving neutrinos, are discussed. The conserved vector current, strange particle decays, and intermediate vector bosons are considered. (C.E.S.)

40349 LEPTONIC DECAYS AND THE UNITARY SYMMETRY. Nicola Cabibbo (CERN, Geneva). p.180-90 of "Strong, Electromagnetic, and Weak Interactions." New York, W. A. Benjamin, Inc., 1964.

An approach to the theory of leptonic decays of strongly interacting particles based on the hypothesis that strong interactions are invariant under the transformations of the unitary group SU_3 is discussed. This approach gives a solution to two problems relating to leptonic processes: the slow rate of strangeness changing leptonic decays and the discrepancy between the Fermi coupling constant as derived from the meson(μ) lifetime and from the ft value for pure Fermi beta decays. (C.E.S.)

40350 ELASTIC SCATTERING, POLARIZATION AND INELASTIC COLLISIONS OF ANTIPROTONS ON PROTONS AT 3 AND 3.6 Gev/c. Y. Goldschmidt-Clermont (CERN, Geneva). p.191-208 of "Strong, Electromagnetic, and Weak Interactions." New York, W. A. Benjamin, Inc., 1964.

Results obtained from bubble chamber photographs on the p-$\bar{p}$ interaction at 3.0 and 3.6 Bev/c were discussed. Cross sections, elastic scattering, polarization, and inelastic collisions with single-meson(π) production are considered. (C.E.S.)

40351 $\pi^{\pm}$-p AND p-p ELASTIC SCATTERING AT HIGH ENERGIES. G. Giacomelli (Università, Bologna and CERN, Geneva). p.209-16 of "Strong, Electromagnetic, and Weak Interactions." New York, W. A. Benjamin, Inc., 1964.

An experiment on $\pi^{\pm}$-p and p-p elastic scattering using spark chamber techniques is described. The π^--p and p-p scattering data were taken at 8, 12, and 18 Bev/c, while π^+-p data were taken at 8 and 12 Bev/c. The geometry covered all scattering angles between 1.25 and 7.45° corresponding to values for the square of the Lorentz invariant four-momentum transfer between 0.04 and 3$(Bev)^2$. (C.E.S.)

40352 PHOTOPRODUCTION AND NEUTRAL DECAY MODES OF THE η PARTICLE. V. Silvestrini (Laboratori Nazionali, Frascati, Italy). p.217-33 of "Strong, Electromagnetic, and Weak Interactions." New York, W. A. Benjamin, Inc., 1964.

A spark chamber was used to investigate the photoproduction and neutral decay modes of the meson(η). The γ-ray beam of the electron synchrotron was used with a liquid hydrogen target to produce the interaction $\gamma + p \rightarrow \eta + p$. (C.E.S.)

40353 μ PAIR PRODUCTION. R. Weinstein (Northeastern Univ., Boston). p.234-6 of "Strong, Electromagnetic, and Weak Interactions." New York, W. A. Benjamin, Inc., 1964.

An experiment on meson(μ) photoproduction at large angles is discussed. The experiment is primarily designed to search for a breakdown in quantum electrodynamics at small distances. The experiment should ultimately probe a distance of about 4×10^{-15} cm. (C.E.S.)

40354 RADIATIVE MUON CAPTURE IN Ca^{40}. R. Diebold (CERN, Geneva). p.237-41 of "Strong, Electromagnetic, and Weak Interactions." New York, W. A. Benjamin, Inc., 1964.

An experiment to measure the fraction of mesons(μ^-) that initiate the reaction $\mu^- + p \rightarrow \nu_\mu + n + \gamma$, where p is a proton in the ^{40}Ca nucleus, is discussed. (C.E.S.)

40355 PROBLEMS OF HIGH ENERGY PHYSICS. Victor Weisskopf (CERN, Geneva). p.33-50 of "Lectures on Nuclear Interactions. Vol. I." [Belgrade], Federal Nuclear Energy Commission of Yugoslavia, 1962.

The "elementary" particles are discussed in terms of three actaul elementary particles (electron, neutrino, and nucleon) and two types of nuclear field quanta – mesons (K) and (π). (D.C.W.)

40356 PHOTODISINTEGRATION OF DEUTERONS AND N–P CAPTURE. p.363-88 of "Lectures on Nuclear Interactions. Vol. I." [Belgrade], Federal Nuclear Energy Commission of Yugoslavia, 1962.

Some calculations of the photodisintegration of deuterons are discussed in relation to experimental observations; and the inverse process $n + p \rightarrow d + \gamma$ with fast neutrons is briefly considered, particularly its suitability for studying electromagnetic transitions in n-p and n-light nucleus systems. (D.C.W.)

40357 IDENTIFICATION OF THE "PERSISTING BARYON" AND ITS APPLICATION IN AN ANALYSIS OF

NUCLEAR INTERACTIONS AT HIGH ENERGIES. R. R. Daniel, N. Durgaprasad, P. K. Malhotra, and B. Vijayalakshmi (Tata Inst. of Fundamental Research, Bombay). p.9-13 of "International Conference on Cosmic Rays. Vol. 5." Bombay, Tata Inst. of Fundamental Research, 1964.

The 56 nucleon-initiated jets recorded in the ICEF investigation were used in an attempt to identify the surviving baryon and the highest-energy created particles. The Castagnoli method was used for estimating the energy of the particle initiating the interaction. It is concluded that the incident nucleon emerges from the collision carrying on the average about 50% and always greater than 10% of the original energy. Among the created particles, the one having the highest energy has on the average 5% and almost never more than 10% of the primary energy. The mean number of nuclear active particles with energies exceeding 10% of the incident energy is 1.1 ± 0.2 per jet. The average inelasticity for the nucleon-emulsion nuclei interactions is about 0.5 ± 0.15. Charge persistence was found to be 0.74. The ratio of interactions produced by neutral to those produced by charged created particles is discussed. (A.G.W.)

40358 STUDY OF NATURE AND PROPERTIES OF SECONDARY PARTICLES PRODUCED BY COSMIC RAY NUCLEONS AT HIGH ENERGY. N. A. Dobrotin, N. G. Zelevinskaya, K. A. Kotelnikov, V. M. Maximenko, V. S. Puchkov, S. A. Slavatinskii, and I. N. Fetisov (Lebedev Inst. of Physics, Moscow). p.79-84 of "International Conference on Cosmic Rays. Vol. 5." Bombay, Tata Inst. of Fundamental Research, 1964.

Experimental data on nucleon-nucleon collisions were used to study details of the investigated process. The momentum distribution in the region of higher momenta was obtained by transformation into the mirror system. A possible explanation of the fact that the experimental number of particles with very high energy exceeds the calculated number is considered. It is suggested that the inelasticity coefficient is independent of the primary energy and that the dependence reported by some authors is caused by an incorrect method of determining primary energy. Analysis of the total experimental material indicated that the fraction of strange particles among the secondaries was $\leq 6\%$. (A.G.W.)

40359 MOMENTUM SPECTRUM OF FAST SECONDARIES IN HIGH ENERGY COLLISIONS. H. H. Aly, M. F. Kaplon, and M. L. Shen (Univ. of Rochester, N. Y.). p.85-90 of "International Conference on Cosmic Rays. Vol. 5." Bombay, Tata Inst. of Fundamental Research, 1964.

Equations are given to represent (1) the distribution of the transverse momentum of the secondary shower particles in high-energy collisions and (2) the total momentum distribution of the secondary shower particles in the laboratory system. The first equation is based on the assumption that secondary particles are emitted symmetrically with respect to the collision axis of the interacting particles. Both equations are shown to fit with experimental data on high-energy interactions. (A.G.W.)

40360 THEORETICAL ASPECTS OF HIGH ENERGY INTERACTIONS. B. M. Udgaonkar (Tata Inst. of Fundamental Research, Bombay). p.93-104 of "International Conference on Cosmic Rays. Vol. 5." Bombay, Tata Inst. of Fundamental Research, 1964.

Two theoretical proposals are reviewed. The first is the bootstrap mechanism for generating bound states and resonances, which is of interest in connection with the question of what constitutes an elementary particle. Known particles and resonances are listed, and the bootstrap idea is illustrated by the example of π-π scattering. Second, some of the applications of the Regge pole idea in high-energy scattering are surveyed. It is suggested that some apparent failures of the theory may be due to drastic oversimplifying assumptions. Predictions about cross sections at energies higher than those presently available are discussed. (A.G.W.)

40361 PARTICLE PRODUCTION AT Gev ENERGIES. W. O. Lock (CERN, Geneva). p.105-38 of "International Conference on Cosmic Rays. Vol. 5." Bombay, Tata Inst. of Fundamental Research, 1964.

Present knowledge about pion production by protons and by pions in the energy range 2-25 Bev is summarized. Most of the information comes from hydrogen bubble chamber experiments and from counter experiments by the Cocconi group at CERN. Attempts to separate proton-nucleon and pion-nucleon collisions in nuclear emulsions from interactions with complex nuclei are mentioned briefly. Particular attention is given to experiments providing information on the formation of nucleon isobars at different energies. (47 references) (A.G.W.)

40362 EXPERIMENTAL INVESTIGATION OF NUCLEAR INTERACTIONS AT ENERGIES OF 10^{11} TO 10^{13} ev (BY THE DATA OF RESEARCH IN THE USSR). N. A. Dobrotin, N. L. Grigorov, Zh. Takibaev, and G. B. Zhdanov. p.141-65 of "International Conference on Cosmic Rays. Vol. 5." Bombay, Tata Inst. of Fundamental Research, 1964.

Methods and equipment developed in recent years for studying nuclear interactions at high energies and experimental results obtained are reviewed. The importance of and difficulties involved in cosmic-ray experiments to provide data at energies higher than those available with accelerators are pointed out. Various theories concerning nucleon-nucleon interactions and pion generation are discussed with respect to recent experimental data. Suggestions are made for work that can and should be done in the future. (A.G.W.)

40363 POSSIBLE STUDIES ON THE STRUCTURE OF THE NUCLEONS AND TESTS ON CHARGE SYMMETRY FROM NUCLEAR COLLISIONS AT HIGH ENERGIES. A. Subramanian (Tata Inst. of Fundamental Research, Bombay). p.166-81 of "International Conference of Cosmic Rays. Vol. 5." Bombay, Tata Inst. of Fundamental Research, 1964.

Starting from the observation that the dominant inelastic collision between nucleons is characterized by peripherality (cloud-cloud collisions), available experimental data on nucleon-nucleon and pion-nucleon collisions at energies $\gtrsim 10$ Bev are examined to indicate the sort of meson cloud structure around the nucleon that is necessary to explain the data. It is pointed out that the nucleon probably has a peripheral two-pion cloud of mass ≈ 310 Mev in the $I = 0$ state corresponding to the so-called ABC particle. This peripheral meson cloud appears to play a more important role in high-energy nuclear collisions than the usually assumed peripheral cloud of pions. The question of charge symmetry in the production of pions in nuclear collisions and in the inelastic collision between the nucleons in their different states of charge at high energies is briefly discussed, and it is pointed out that a detailed study of inelastic nuclear collisions at high energies may indicate deviations, if any, from the hypothesis of charge symmetry and charge independence in nuclear interactions. (auth)

40364 COSMIC RAYS AND THE THEORY OF STRONG INTERACTIONS. D. S. Chernavskii and E. L. Feinberg

(Lebedev Inst. of Physics, Moscow). p.395-422 of "International Conference on Cosmic Rays. Vol. 5." Bombay, Tata Inst. of Fundamental Research, 1964.

The following are included in this review: the Regge pole method, a one-meson approximation, a multiperipheral model, and their correlation with experimental data; the interrelation of elastic and quasi-elastic collisions within the scope of the above methods; the role of the hydrodynamical model; a survey of theoretical conclusions that could, in principle, be checked experimentally, and the concrete problems that the theory is able to offer to the experiment. It is concluded that experimental investigation of strong interactions in cosmic rays is both necessary and promising for at least the next ten years. (23 references) (A.G.W.)

40365 MESON PRODUCTION AT HIGH ENERGY AND SECONDARY COSMIC RADIATION. B. Peters (Universitet, Copenhagen). p.423-42 of "International Conference on Cosmic Rays. Vol. 5." Bombay, Tata Inst. of Fundamental Research, 1964.

An experiment carried out by Damgaard and Hansen at the CERN machine is described. It consists of measuring the energy and angular distribution of mesons created by 22-Bev protons in LiH in the backward hemisphere and provides an example of the meson production spectrum at accelerator energies. It is suggested that two processes can adequately explain meson production in secondary cosmic radiation: (1) excitation of the colliding baryons to low-lying non-strange states of the pion-nucleon system and their subsequent decay, and (2) the evaporation from a center moving slowly in the C-system, of baryon pairs or of mesons with a spectrum similar to that found in the annihilation of slow baryon-antibaryon pairs. Facts pointing directly toward the dominant role that mesons from isobar decay play in secondary cosmic radiation involve the muon charge ratio at sea level, the kaon charge ratio in emulsion stacks exposed at balloon altitudes, and relations between the members of γ ray families. Speculation on the nature of fireballs is presented. (A.G.W.)

40366 GENERAL DISCUSSION (ISOBAR MODELS). p.467-83 of "International Conference on Cosmic Rays. Vol. 5." Bombay, Tata Inst. of Fundamental Research, 1964.

Models for high-energy interactions, calculated predictions and consequences of the models, experimental evidence both for and against the models, areas in which more data are specifically needed, and experiments planned or in progress and expected to supply more data are discussed. Most of the material is presented in other papers at the conference. (A.G.W.)

40367 SOME NEW MATHEMATICAL FEATURES IN CASCADE THEORY. A. Ramakrishnan (MATSCIENCE, Madras), R. Vasudevan, and S. K. Srinivasan. p.498-501 of "International Conference on Cosmic Rays. Vol. 5." Bombay, Tata Inst. of Fundamental Research, 1964.

The theory of product densities is applied to the problem of fluctuation in the size of cascade showers. The general method consists in defining various types of product densities and obtaining the differential equations satisfied by them. Though the equations were written down for the number distributions of electrons and photons in an electromagnetic cascade, the methods are equally applicable to any branching process involving very many species of particles. (A.G.W.)

40368 FLUCTUATION PROBLEM IN ELECTROMAGNETIC CASCADES. S. K. Srinivasan, K. S. S. Iyer, and N. V. Koteswara Rao (Indian Inst. of Tech., Madras). p.502-5 of "International Conference on Cosmic Rays. Vol. 5." Bombay, Tata Inst. of Fundamental Research, 1964.

In electromagnetic cascade theory, $\pi_i(n,E|E_0;\ t)$, is defined as the probability that n electrons are produced between 0 and t, each of which has a primitive energy greater than E. As t tends to infinity, the moments of the function $\pi_i(n,E|E_0;\ t)$ tend to a non-zero limit denoted by $\pi_i(n,E|E_0)$. In this paper analytic expressions for all the moments of $\pi_i(n,E|E_0)$ are obtained. The general method is outlined, but details of the calculations will be published elsewhere. (A.G.W.)

40369 A SYSTEM OF THE ELEMENTARY PARTICLES. A. Ehmert (Max-Planck-Institut für Aeronomie, Northeim, Ger.). p.506-13 of "International Conference on Cosmic Rays. Vol. 5." Bombay, Tata Inst. of Fundamental Research, 1964.

A formula is given, which represents the empirical masses of the elementary particles and of the known resonances by two quantum numbers u and v. A classification of the particles is given by u. Hyperons prove to be composed of a nucleon and a particle with different quantum numbers. The formula can be understood by a model composing the particles out of different submasses, probably parts of an electromagnetic oscillation system. One quantum number rules phase conditions between neighboring submasses and the other counts the number of submasses in the particle. The model fixes radii for the different parts in fair agreement with the results of high-energy electron scattering by nucleons. By adopting subcharges related to the submasses in a simple manner it is possible to find relations that ensure the right total electric charge as well as the right total magnetic moments for the muon, the proton, and, with precise changes in the model, for the neutron. Evidence is given concerning electron linkage to the system of the heavier particles. (auth)

40370 GENERAL DISCUSSION OF HIGH ENERGY INTERACTIONS. N. A. Dobrotin. p.561-6 of "International Conference on Cosmic Rays. Vol. 5." Bombay, Tata Inst. of Fundamental Research, 1964.

Work done and problems solved in the field of high-energy interactions in the past two years are summarized. Some contradictory views on fireball and isobar models are expressed. Elastic scattering cross sections in the region of some hundreds of Bev are discussed briefly. (A.G.W.)

40371 LINKED HEAVY PARTICLE MODEL AND MULTIPLE PARTICLE PRODUCTION. Tetsuro Kobayashi, Mikio Namiki, and Ichiro Ohba (Waseda Univ., Tokyo). p.569-72 of "International Conference on Cosmic Rays. Vol. 5." Bombay, Tata Inst. of Fundamental Research, 1964.

Possibilities for a linked heavy-particle model other than the pion multiperipheral model are porposed. Here the nucleon cloud is composed of central nucleon-nucleon pairs covered with a heavy meson layer and a pion cloud as outer skin. The multiple particle production takes place almost exclusively in the inner cloud of either or both of the colliding particles, where a number of fireballs will be produced through heavy particle links. The four momentum transfer squared for each link and the mass of each fireball are fundamental parameters in this model. The multiplicity of fireballs is proportional to log E_L, E_L being the incident energy in the laboratory system. Possible asymmetric excitation of the inner clouds may lead to forward-

backward asymmetry in produced particles. The smallest inelasticity and the largest inelasticity are expected for the pion link and the nucleon link respectively. The model is shown to be consistent with recent experiments. (A.G.W.

40372 NUCLEON-NUCLEON AND PION-NUCLEON INTERACTIONS AT VERY HIGH ENERGIES. I. A. Kuchin and P. A. Usik (Inst. of Nuclear Physics, Alma-Ata, USSR). p.573-6 of "International Conference on Cosmic Rays. Vol. 5." Bombay, Tata Inst. of Fundamental Research, 1964.

The most general one-pion-exchange diagrams of inelastic NN and πN scattering are shown. Cross sections for these interactions are calculated. Theoretical and experimental distributions of the inelasticity coefficient are shown. (A.G.W.)

40373 ON THE IDENTIFICATION OF THE SECONDARY PARTICLES WITH THE ENERGY $\leq 2 \times 10^{10}$ ev BY THE EMULSION METHOD AND THE RESULTS ON (P-N) (π^--N) INTERACTIONS. E. G. Boos, V. A. Botvin, A. Kh. Vinitskii, Zh. S. Takibaev, and I. Ya. Chasnikov (Inst. of Nuclear Physics, Alma-Ata, USSR). p.585-9 of "International Conference on Cosmic Rays. Vol. 5." Bombay, Tata Inst. of Fundamental Research, 1964.

Results of the following studies are shown in figures: (1) multiple scattering of protons with energies 0.66, 2, 4, 9, and 10 Bev and π mesons with energies 3.8, 7.5, and 17 Bev in nuclear emulsions; (2) inelasticities and angular distributions of interactions of 9-Bev protons with nucleons; (3) momentum distributions for interactions of 7.5-Bev π^- mesons with protons and neutrons; and (4) Lorenz factors and asymmetry values for interactions of 20-Bev protons with nucleons. (A.G.W.)

40374 ELECTRON-PAIR THEORY OF MESON STRUCTURE AND THE INTERACTIONS OF NUCLEAR PARTICLES. E. J. Sternglass (Westinghouse Research Labs., Pittsburgh). 54p. (CONF-481-75)

From American Physical Society Annual Meeting, New York, Jan. 1964.

The hypothesis is investigated that the electron and positron may be the basic particles from which the various types of mesons may be constructed and their interactions explained. Following along the lines used earlier to arrive at a Bohr-type electron-pair model of the neutral π meson, models are developed for the charged π and μ mesons. The masses, spins, and magnetic moments of these particles are calculated and found to be in good agreement with the observed values. The lifetimes of the $\pi^\pm$ and $\mu^\pm$ decays are calculated as radiative transitions of these highly relativistic electron-positron systems, whose excited states are found to be quantized in units of (h/2). Due to the extremely relativistic nature of these radiating systems, the normal electron mass is found greatly increased with a corresponding decrease in the matrix element and rate of radiation, thereby providing a possible explanation of the weakness of β decay. The radiation quanta emitted carry spin h/2 and have opposite helicities, in agreement with a two-component theory of the neutrino. An examination of the forces between two pions shows the force to be of a short-range exchange character, with a strength and range that agrees with the observed properties of nuclear forces, including charge independence, the existence of a repulsive core, and the dependence on isotopic spin. The latter is shown to be connected with the internal angular momentum of the meson models arrived at. By contrast, the muons are found not to be capable of forming short-range exchange bonds with pions, thereby explaining the failure of muons to interact strongly with nuclei. As a result of the great strength of the pion-pion forces, molecular-type systems containing two or more pions can be constructed. The ground-states of 2π, 3π, and 4π systems are found to fit the masses of the K and η mesons, while their rotational excited states fit the properties of all the presently known pion-resonances. (auth)

40375 CERN NEUTRINO EXPERIMENT. J. M. Gaillard (CERN, Geneva). 26p. (CONF-481-76)

From American Physical Society Annual Meeting, New York, Jan. 1964.

The CERN neutrino experiment was run for $6\frac{1}{2}$ weeks with neutrinos and one week with antineutrinos. Protons were focused on a Cu target and the pions and kaons produced were allowed to decay to produce neutrinos. The neutrinos were detected by a heavy-liquid bubble chamber followed by a set of spark chambers. During neutrino runs, 219 events were obtained in the bubble chamber and about 4000 in the spark chamber. Evidence is presented that the events obtained were really induced by neutrinos. The results are discussed with respect to the following: two types of neutrinos, the neutrino flip hypothesis, lepton conservation, neutral lepton currents, strange particle production, elastic events and form factors, and inelastic events. A systematic analysis of the spark chamber data on charged lepton pairs indicates that the intermediate boson does exist and that it should have a mass lying between 1250 and 1650 Mev. (A.G.W.)

40376 POSSIBLE NON-RESONANT CHARACTER OF THE κ. Wilson W. S. Au (Univ. of Colorado, Boulder). 9p. (CONF-481-77)

From American Physical Society Annual Meeting, New York, Jan. 1964.

It is proposed that the peak in the Kπ mass spectrum at ~726 Mev with a tentative width of less than ~20 Mev, the so-called κ, is not a resonance but a non-resonant bump that could appear in the following way. Suppose the Kπ P-wave phase shift δ is zero at threshold and just above threshold, it takes on negative values. Since δ must eventually become 90° at the K* mass, it must go through zero again. When δ is zero, the cross section is also zero and hence between the two energies where δ is zero, a bump will appear. This behavior in δ is characteristic of a potential that is non-monotonic as a function of the interparticle distance. The discussion assumes that the κ is in the 1^- state rather than the 0^+ state. A fit to the data is made with the boundary condition model to illustrate the possibility of this mechanism for explaining the κ. (A.G.W.)

40377 FOUR-PRONGED INTERACTIONS IN π^--p COLLISIONS AT 2.0 Bev. P. R. Satterblom. 4p. (CONF-452-48)

From American Physical Society, Washington, D. C., Apr. 1964.

An analysis is presented of 2128 events produced by π^- mesons incident on protons at 2.1 Bev/c, in which four charged secondaries and at most one neutral secondary are produced. It is found that for two-pion production at this energy, the 3-3 isobar is an important channel for events having low momentum transfer, but that core-type processes must dominate. Events having three pions are essentially core-formed, with ω production being appreciable in cases in which a neutral pion is available. (T.F.H.)

40378 EVIDENCE FOR A (K$\pi\pi$) RESONANCE WITH A MASS OF 1.230 Gev/c^2. R. Armenteros (CERN, Geneva), D. N. Edwards, T. Jacobsen, et al. 10p. (CONF-452-53)

From American Physical Society, Washington, D. C., Apr. 1964.

A total of 770 events of the type $\bar{p} + p \rightarrow K_1^0 + K_1^0 + \pi^+ + \pi^-$ at rest in a hydrogen bubble chamber is studied. The $(K_1^0\pi^+\pi^-)$ distribution exhibits a pronounced enhancement in the neighborhood of 1.230 Bev/c^2. Reasons are brought forth to explain the hypothesis that this enhancement could be considered as a $(K\pi\pi)$ resonant state, with a width of 80 Mev/c^2. (T.F.H.)

40379 MEASUREMENT OF THE A PARAMETER IN PROTON-PROTON SCATTERING AT 50 Mev. A. Ashmore (Rutherford High Energy Lab., Chilton, Eng.), M. Devine, J. Litt, W. H. Range, M. E. Shepherd, and R. L. Clarke. 9p. (CONF-452-55)

From American Physical Society, Washington, D. C., Apr. 1964.

The parameter (A) that describes the coupling between the component of polarization in the direction of the incident beam and the transverse component, in the scattering plane, of the beam, is measured for the scattering of 50-Mev polarized protons by protons. The beam protons are polarized such that the polarization and velocity vectors are parallel. The A values are used to calculate S, P, and D wave phase shifts. (T.F.H.)

Field Theory and Quantum Mechanics

40380 (CAR-882-6) BOOTSTRAP DYNAMICS AND PARTICLE SYMMETRIES. R. E. Cutkosky, M. Leon, and K. Y. Lin (Carnegie Inst. of Tech., Pittsburgh). Contract [AT(30-1)-1825]. 5p. (CONF-550-46)

From the International Conference on High-Energy Physics, Dubna, USSR, Aug. 1964.

A mechanistic theory of symmetries of strongly interacting particles is discussed. Dynamic self-consistency (bootstrap dynamics) is considered and its resemblance to physical situations is discussed. (R.E.U.)

40381 (NP-14330) AN ALGEBRAIC APPROACH TO QUANTUM FIELD THEORY. Daniel Kastler and Rudolf Haag (Illinois. Univ., Urbana). [1963]. 39p.

It is shown that two Quantum Theories dealing respectively in the Hilbert spaces of state vectors $\mathcal{H}_1$ and $\mathcal{H}_2$ are physically equivalent whenever a faithful representation of the same abstract algebra of observables exists in both spaces, no matter whether the representations are unitarily equivalent or not. This allows a purely algebraic formulation of the theory. The framework of an algebraic version of Quantum Field Theory is discussed and compared with the customary operator approach. It is pointed out that one reason (and possibly the only one) for the existence of unitarily inequivalent faithful, irreducible representations in Quantum Field Theory is the (physically irrelevant) behavior of the states with respect to observations made infinitely far away. The separation between such global features and the local ones is studied. An application of this point of view to superselection rules shows that, for example, in Electrodynamics the Hilbert space of states with charge zero carries already all the relevant physical information. (auth)

40382 (RM-4103-PR) STATISTICAL DESCRIPTIONS OF FREE BOSON FIELDS. Dennis Holliday (RAND Corp., Santa Monica, Calif.). Aug. 1964. Contract AF49(638)-700. 21p. (AD-603619)

Two new methods of describing statistical light beams were recently published. Glauber has introduced the P-representation of boson field density matrices, and Sudarshan has developed a probability functional approach that is claimed to imply an equivalence between the classical and quantum mechanical descriptions of statistical light beams. It is shown that using conventional stochastic process methods in the Heisenberg picture to describe a light beam produced by a statistical ensemble of classical (c-number) sources is equivalent to representing the statistical state of the light beam by a density matrix having a P-representation. The relation between the classical and quantum statistical descriptions implied by Sudarshan's probability functional approach is shown to be purely formal and without physical meaning. Sudarshan's statement that the probability functional method can be used to prove that all the correlation functions of the beam determine its density matrix is demonstrated to be incorrect. (auth)

40383 SPINORAL ELECTRODYNAMICS OF INTERACTING CHARGES. N. V. Mitskevich (Univ. of the Friendship of Nations Patrice Lumumba, Moscow). Compt. Rend. Acad. Bulgare Sci., 17: 543-4(1964).

J. Wheeler (Gravitation, Neutrino, and the Universe) developed the idea of discussing the self-consistency of a system of two interacting fields in the form of a higher order nonlinear field. The same approach was extended to the system of electron-positron and electromagnetic fields without introducing any new hypotheses and staying within the framework of the traditional Maxwellian electromagnetic theory and Dirac's spinoral electrodynamics. The results obtained in a Lorentz invariant form can be easily extended to the case of the general theory of relativity since the new lagrangian contains second derivatives of the wave function, the theory encompasses also bispins, and the particle spin may take spin values different from $\frac{1}{2}$. There are 1 Soviet and 6 Western references. (OTS)

40384 FUNDAMENTAL FORMULAE FOR A MULTIDIMENSIONAL REAL SPINOR AND AN ALGEBRAIC MODEL OF QUANTIZED WAVE FIELDS. G. A. Zaitsev. Dokl. Akad. Nauk SSSR, 156: 294-7(May 11, 1964). (In Russian)

A clear algebraic model describing the case in which σ and μ indices assume only a finite number of integral values, found within 1 to n_b and n_c limits, was sought in order to resolve mathematical problems related to the basic principles of the theory of quantized fields. It was shown that a generalized theory of real spinors can be utilized as such a model. Moreover, it is also possible to apply the equation for determining a vacuum to the principal formulas for one real spinor. (R.V.J.)

40385 INVESTIGATION OF QUANTUM THEORY OF COLLISIONS. V. D. Kamenetskii (All Union Correspondence School of Textile and Light Industry, USSR). Izv. Vysshikh Uchebn. Zavedenii, Fiz., No. 2, 60-5(1964). (In Russian)

An analytical method suggested for the precise solution of quantum mechanics of elastic scattering of particles in a static field was generalized, in distorted-wave approximation without exchange, for the case of atomic excitation induced by electron impact. Analytical aspects were established for the fundamental bond between the behavior of the wave functions for particle scattering, and wave functions and scattering amplitudes were determined. The developed theory was used for resolving the problem of the excitation of the hydrogen 2S level. (tr-auth)

40386 QUANTUM CELL MODEL EQUATION OF STATE. Ian H. Hillier and John Walkley (Imperial Coll. of Science and Tech., London). J. Chem. Phys., 41: 2168-74(Oct. 1, 1964).

A quantum-mechanical cell model equation of state was developed using the Wentzel-Kramers-Brillouin approximation to solve the Schrödinger wave equation. Compressibility data for hydrogen, deuterium, and helium was obtained for a Lennard-Jones 12–6 potential, over a wide range of temperature and density. A comparison with experiment shows the expected good agreement in the solid state, the agreement becoming progressively worse for the liquid and gas phases. (auth)

40387 EXACT SOLUTION OF THE SCHRÖDINGER EQUATION FOR INVERSE FOURTH-POWER POTENTIAL. Richard M. Spector (Univ. of Rochester, N. Y.). J. Math. Phys. (N. Y.), 5: 1185-9(Sept. 1964). (UR-875-23)

The solution of the Schrödinger equation for the potential $V(r) = V/(\mu r)^4$ and all angular momenta is given in terms of known functions, namely, the solutions to the modified Mathieu equation with complex parameters and complex argument. Scattering solutions for both attractive and repulsive potentials are given, and in the latter case the explicit expression for the S matrix is given. (auth)

40388 LINEAR REPRESENTATION OF SPINOR FIELDS BY ANTISYMMETRIC TENSORS. John R. Klauder (Bell Telephone Labs., Inc., Murray Hill, N. J.). J. Math. Phys. (N. Y.), 5: 1204-14(Sept. 1964).

A redundant, linear representation of four-component spinors $\psi(x)$ by antisymmetric tensors $f_{\mu\nu}(x)$ is proposed on the basis of the relation $\psi = \frac{1}{2} f_{\mu\nu}\gamma^{\mu\nu} v$, where $\gamma^{\mu\nu}$ is the skew product of gamma matrices and v is a constant fiducial spinor. The redundant degrees of freedom in $f_{\mu\nu}$ as well as the particular choice of v are both treated as unobservable gauges, and the appropriate gauge groups are discussed. As part of this analysis, it is demonstrated that the possibility that tensors can behave as spinors is intimately connected with the existence of two coordinate-invariant, gauge-covariant subsidiary conditions. A linear, tensorial reformulation of the Dirac equation is given, and shown to be the Euler-Lagrange equation of the conventional action functional for spinor fields. Finally covariance under arbitrary space-dependent coordinate and gauge transformations is discussed, and a generally covariant, tensorial form of the Dirac equation is proposed differing from the conventional generally covariant equation in the degree of arbitrariness in the (spin) connection. (auth)

40389 A THEOREM ON THE DETERMINANTAL SOLUTION OF THE FREDHOLM EQUATION. Irwin Manning (Naval Research Lab., Washington, D. C.). J. Math. Phys. (N. Y.), 5: 1223-5(Sept. 1964).

For a Fredholm equation with Green's-function-type kernel, a new proof is given of a known theorem relating the Fredholm determinant with the behavior of the solution at the origin. The utility of this theorem in practical calculations is pointed out, as are some of its implications for potential scattering in quantum mechanics. The scattering phase shift is shown to have the property $(\partial/\partial\lambda)\delta(E,\lambda) = -\pi \langle \psi_E | V | \psi_E \rangle$. (auth)

40390 NONRELATIVISTIC COULOMB GREEN'S FUNCTION IN MOMENTUM SPACE. Levere Hostler (Yale Univ., New Haven). J. Math. Phys. (N. Y.), 5: 1235-40(Sept. 1964).

The nonrelativistic Coulomb Green's function in momentum space is obtained in closed form by Fourier transforming the known expression for the coordinate-space Green's function. Also, an integral representation for the momentum-space Green's function is obtained which looks rather attractive from the point of view of applications. (auth)

40391 A MODEL OF INTERACTING RADIATION AND MATTER. Charles R. Willis (Boston Univ., Mass.). J. Math. Phys. (N. Y.), 5: 1241-52(Sept. 1964).

The long-time behavior of a model consisting of N two-level atoms in a lossless cavity is investigated. The hamiltonian of the system contains the radiation oscillators in addition to the matter hamiltonian and the usual $\int j \cdot A dv$ interaction term. In order to treat the system perturbatively, it would be necessary to remove the tremendous degeneracy of the system. Since this is prohibitively difficult, and since the long-time behavior of the system is to be investigated, the quantum mechanical Liouville equation is solved directly for a wide class of physically important initial distribution functions. It is shown that the effective expansion parameter is $\tilde{\gamma} N \tilde{\gamma}$ where $\tilde{\gamma}$ is a dimensionless atomic dipole moment and N is the number of atoms. In the lowest order the self-consistent field approximation is found. In the next order, particle-field correlations appear. The equations of motion for the particle-field correlations are explicitly solved in terms of the average quantities that appear in the self-consistent field approximation. It is shown that the self-consistent field approximation consists of five first-order differential equations and that the equations of motion for the density matrix of the system correct to order $(\tilde{\gamma} N \tilde{\gamma})^2$ are equivalent to eight first-order differential equations. The three additional equations are needed to describe the three second moments of the density matrix of the electromagnetic field that appear in second order. The lowest-order microscopic equations are equivalent to semiphenomenological theories and the higher-order equations contain only the measurable second-order moments of the electromagnetic field in addition to the variables that appear in semi-phenomenological theories. (auth)

40392 ON SOME TOPOLOGICAL PROPERTIES OF FEYNMAN GRAPHS AND THEIR APPLICATION TO FORMULAS RELATED TO THE FEYNMAN AMPLITUDES. Yutze Chow (Brandeis Univ., Waltham, Mass.). J. Math. Phys. (N. Y.), 5: 1255-60(Sept. 1964).

The usefulness of the topological concept of the tree sets introduced into any Feynman graph is demonstrated. A relation between certain functions appearing in two different forms of parametrized Feynman amplitudes is demonstrated by using the properties of the tree sets and some purely determinantal manipulations. As another exposition, an alternative proof of a theorem due to Nakanishi is shown by using only the concept of tree sets with almost no algebraic manipulation involved; the proof in this case is seen to be particularly simple and lucid. (auth)

40393 EXACT QUANTIZATION RULES FOR THE ONE-DIMENSIONAL SCHRÖDINGER EQUATION WITH TURNING POINTS. Paul B. Bailey (Sandia Lab., Albuquerque, N. Mex.). J. Math. Phys. (N. Y.), 5: 1293-7 (Sept. 1964).

It is pointed out that, for a number of problems, exact quantization rules exist which closely resemble that of Bohr-Wilson-Sommerfeld. In some cases it is shown how these rules may be derived mathematically from the Schrödinger equation. (auth)

40394 QUANTIZATION OF ELECTRODYNAMICS IN THE AXIAL GAUGE. York-Peng Yao (Harvard Univ., Cambridge, Mass.). J. Math. Phys. (N. Y.), 5: 1319-21 (Sept. 1964).

The so-called axial gauge condition $A_3(x) = 0$ is shown to be inconsistent with the condition of Lorentz invariance. This inconsistency is resolved. (auth)

40395 SPIN AND STATISTICS WITH AN ELECTROMAGNETIC FIELD. York-Peng Yao (Harvard Univ., Cambridge, Mass.). J. Math. Phys. (N. Y.), 5: 1322-6 (Sept. 1964).

Because of the impossibility of simultaneously satisfying the requirements of manifest Lorentz covariance and positive-definite (finite) norm in the Hilbert space, no simple proof of the connection between spin and statistics with an electromagnetic field was given. It is pointed out that it is indeed not necessary to have manifest Lorentz covariance in the full 3 + 1 space to show such a connection. Using the axial gauge $A_3 = 0$, a simple straightforward proof was successfully constructed. (auth)

40396 EVOLUTION OF THE DENSITY MATRIX OF LARGE SYSTEMS. [PART] II. L. Blum (Facultad de Ciencias Exactas y Naturales, Buenos Aires). J. Phys. Soc. Japan, 19: 1093-5(July 1964).

The evolution equation for a particle in a homogeneous fluid is generalized to the case of many particles. The correct limiting expressions are obtained for the case of one particle and of random a priori phases. (auth)

40397 ON CERTAIN DIFFICULTIES OF NON-LINEAR SPINOR FIELD THEORIES. C. Hirsch (Université Libre, Brussels). Nucl. Phys., 59: 353-63(Oct. 1964).

Two problems arising in nonlinear spinor field theories are discussed. One of these problems concerns general nonlinear field equations and is connected with the behavior of the anticommutator at the origin of the light cone. It is shown that the resolution of the nonlinear equation by means of the new Tamm-Dancoff method is not self-consistent, if anticommutativity of the fields at the same point is assumed. A consistent resolution of the equation requires, as a consequence of microscopic causality, an anticommutator with at least δ-type singularities on the light cone. The other problem concerns Heisenberg's theory of elementary particles; it is shown that, in this theory, the nucleon-nucleon scattering amplitude vanishes. In order to get some insight on the validity of the Tamm-Dancoff approximation, first and second order contributions to the Möller scattering amplitude in quantum electrodynamics are computed by means of the Tamm-Dancoff method and compared with the results of perturbation theory. The calculations indicate that the first-order contribution is in accordance with perturbation theory (e^2 terms) while this is no longer the case for the second-order contribution. (auth)

40398 ANALYTICITY AND BOUNDEDNESS PROPERTIES OF GENERALIZED SINGULAR FUNCTIONS IN n-DIMENSIONAL LORENTZ SPACE. Goeran Faeldt (Univ. of Lund, Sweden). Nucl. Phys., 59: 449-59(Oct. 1964).

The generalized singular functions $\Delta^{(n)(+)}_{m+1}(x; a) = [-i/(2\pi)^{n-1}]^m \int \ldots \int \prod_{\alpha=0}^{m-1} dp_\alpha \exp\left(i \sum_{\alpha=0}^{m-1} p_\alpha x_\alpha\right) \prod_{\alpha\leq\beta=0}^{m-1} \delta(p_\alpha p_\beta + a_{\alpha\beta}) \prod_{\alpha=0}^{m-1} \theta(p\alpha)$ in n-dimensional Lorentz space are studied. For all values of m these functions can be expressed in terms of $\Delta^{(n)(+)}_{n+}(x; a)$. As independent variables of this function the eigenvalues σ_α of the matrix Za, where $Z = (-x_\alpha x_\beta)$ and $a = (a_{\alpha\beta})$ can be used. It was shown that $\Delta^{(n)(+)}_{n+}(x; a)$ is regular analytic and exponentially damped for large values of σ_α in a certain domain, the boundary of which is given by $\mathrm{Im}[\pm\sqrt{\sigma_0} \pm \sqrt{\sigma_1} \pm \ldots \pm \sqrt{\sigma_{n-1}}] = 0$. This result was originally found by an explicit calculation of the functions $\Delta^{(n)(+)}_{n+1}(x; a)$ for n = 2,3,4. Here, we give a more general proof from a study of the integrand in the formula. (auth)

40399 REMARKS ON THE HORI METHOD FOR THE TREATMENT OF STRONG COUPLING FIELDS. [PART] I. G. Heber (Karl-Marx-Universität, Leipzig). Nucl. Phys., 59: 481-92(Oct, 1964). (In German)

Difficulties of the Lorentz-invariant strong-coupling-method, recently proposed by Hori are considered. The method uses essentially functional integration and differentiation and is a development in the direction, which e.g., Bogulyubov and Shirkov sketched some years ago. A possible way out of these difficulties is discussed and partly applied. Some remarks on the direction in which this method should be developed further are made. (auth)

40400 REMARKS ON THE HORI METHOD FOR THE TREATMENT OF STRONG COUPLING FIELDS. [PART] II. G. Heber (Karl-Marx-Universität, Leipzig). Nucl. Phys., 59: 493-503(Oct, 1964). (In German)

The interaction of two scalar model fields is treated by the slightly modified Hori method. The modification consists in an application of Güttingers rules for δ-function-products. The functional Ω, which in some sense is a generating functional of the vacuum-expectation-value of S-matrix, shows a remarkable singularity at vanishing coupling between the two fields. One of the simplest Feynman-amplitudes is calculated in some very simple approximations. The result is physically not acceptable. Possible reasons for this defect are discussed. (auth)

40401 MOTION OF A CHARGE IN CHANGING MAGNETIC FIELDS WITH NONADIABATIC INTERVALS. A. Cavaliere, B. Crosignani, and F. Gratton (Euratom CNEN, Rome). Nuovo Cimento (10), 33: 1338-55(Sept. 1, 1964).

The finite variations of the magnetic moment in changing magnetic fields alternating adiabatic with nonadiabatic intervals, are studied using an approximation scheme for second order differential equations introduced by Heading. The process is best assessed by embedding the real time axis in a complex plane, and considering the analytic extension of the motion equation. It is shown that the connection matrix over nonadiabatic intervals depends on the functional characteristic of the field through the configuration and order of its complex zeros, within an error whose upper bound is determined. Also it is shown that the matrix is conserved, when the configuration of the zeros is altered in a way which corresponds to modulations of the field with amplitudes and frequencies depending on the established error. (auth)

40402 ON THE DEFINITION OF SCATTERING IN RELATIVISTIC QUANTUM FIELD THEORY. R. Fong (Iowa State Univ., Iowa City). Nuovo Cimento (10), 33: 1422-36(Sept. 1, 1964).

A relativistic interacting theory for neutron bosons and in which there can be no stable bound states is studied. The theory is obtained by embedding two-particle relativistic quantum mechanics in quantum field theory by means of a procedure recently given by Sudarshan. This results in a theory in which there is scattering in the two-particle channel only. An interacting field operator $\psi(x)$ is defined for the theory. It is then found that under the usual formulation of axiomatic quantum field theory $\psi(x)$ must be regarded as a local free-field operator. However, there is inherent in $\psi(x)$ scattering information. A new asymptotic condition for field operators is then proposed, whereby this scattering information may be extracted. A heuristic discussion of the physical significance of the asymptotic condition is also given. (auth)

40403 HARD-CORE INSERTION IN THE MANY-BODY PROBLEM. J. K. Percus (New York Univ., New York) and G. J. Yevick. Phys. Rev., 136: B290-6(Oct. 12, 1964).

Under many conditions, short-range interparticle forces may be simulated by hard cores. The excluded-volume condition which this implies is equivalent to a single restriction upon the microscopic pair distribution. A short-range nonsingular equivalent potential plays a dominant role in this formulation, and its precise value depends upon the approximation used for the remaining long-range forces. A few of these approximations are examined; they yield simplifications of well-known integral equations in the theory of fluids. Possible perturbation solutions are investigated. For example, the corrections to plasma distributions due to short-range cores can be found in this fashion. The method is generalized by using a single condition on the mean radial distribution, permitting application to quantum mechanics, to mixtures, and to external forces. The special case of the Bose hard-sphere fluid is considered. (auth)

40404 SPATIALLY HOMOGENEOUS SOLUTIONS TO THE EINSTEIN-MAXWELL EQUATIONS. Gerald Rosen (Southwest Research Inst., San Antonio, Tex.). Phys. Rev., 136: B297-8(Oct. 12, 1964).

Two spatially homogeneous line elements, representing two inequivalent solutions to the Einstein-Maxwell equations, are known at present. The relation between the two line elements is pointed out and discussed briefly. (auth)

40405 FALLING CHARGES. Cécile Morette DeWitt (Univ. of North Carolina, Chapel Hill) and Bryce S. DeWitt. Physics, 1: 3-20(July-Aug. 1964).

The radiative damping force on an electrically charged particle falling freely in a static weak gravitational field is computed in the nonrelativistic limit of small velocities. It is shown that, in this limit, the force separates naturally into two components, a conservative part which arises from the fact that the mass of the particle is not concentrated at a point but is partly distributed as electric field energy in the space surrounding the particle, and a nonconservative part which depends linearly on both the velocity and the Riemann tensor. The conservative force is shown to correspond to a repulsive inverse square potential and to make a retrograde contribution to the perihelion precession. The nonconservative part is shown to produce an average energy loss identical with that of the traditional formula which is used for accelerations caused by nongravitational forces. Because the nonconservative force depends on the velocity rather than its second derivative, however, the phenomenon of preacceleration does not occur with gravitational forces. The questions answered by this investigation are of conceptual interest only, since the forces involved are far too small to be detected experimentally. (auth)

40406 QUANTUM MECHANICAL PHASE AND TIME OPERATOR. Leonard Susskind (Cornell Univ., Ithaca, N. Y.) and Jonathan Glogower. Physics, 1: 49-61(July-Aug. 1964).

The phase operator for an oscillator is shown not to exist. It is replaced by a pair of non-commuting sin and cos operators which can be used to define uncertainty relations for phase and number. The relation between phase and angle operators is carefully discussed. The possibility of using a phase variable as a quantum clock is demonstrated, and the states for which the clock is most accurate are constructed. (auth)

40407 ON THE ONE-CENTRE EXPANSION OF MEIJER'S G-FUNCTION. L. A. Edelstein (University Coll., London). Proc. Cambridge Phil. Soc., 60: 533-8 (July 1964).

The expansion of an orbital centered at one point about another point is discussed. Such a situation arises in the wave mechanics of molecular structures, nuclear structures, electron and positron scattering by molecules, and nuclear scattering by nuclei. The one-center expansion of the Meijer G-function is derived. (C.E.S.)

40408 ON THE ONE-REGION TWO-CENTRE EXPANSIONS OF A GENERALIZED COULOMB FIELD IN SPHERICAL POLAR AND PARABOLIC COORDINATES. L. A. Edelstein (University Coll., London). Proc. Cambridge Phil. Soc., 60: 543-6(July 1964).

The problem of expanding a Coulomb potential $1/r_{12}$ in spherical polar coordinates defined relative to two centers A(0,0,−d) and B(0,0,+d) where $2d = D = r_{AB}$ is discussed. Single-region expansions of a generalized Coulomb potential $r-n_{12}$ for all values of n, integral or otherwise, positive or negative, are derived. (C.E.S.)

40409 THE FORMULATION OF QUANTUM MECHANICS IN TERMS OF PHASE SPACE FUNCTIONS. D. B. Fairlie (St. Andrews Univ., Fife, Scotland). Proc. Cambridge Phil. Soc., 60: 581-6(July 1964).

A relation between the hamiltonian of a system and its distribution function in phase space is sought which will guarantee that the average energy is the weighted mean of the hamiltonian over phase space. This relation is shown to imply the existence of a wave function satisfying the Schrödinger equation, and dictates the possible forms of time-dependence of the distribution function. (auth)

40410 DIRAC SPACE. Gaisi Takeuti (Tokyo Univ. of Education). Proc. Japan Acad., 38: 414-18(Oct. 1962).

The validity of the method used by Dirac in his theory of quantum mechanics to put the self-adjoint operators t• and 1/i d/dt in diagonal forms is shown. (D.C.W.)

40411 A GENERALIZED QUASI-SPIN FORMALISM. B. H. Flowers and S. Szpikowski (Univ. of Manchester, Eng.). Proc. Phys. Soc. (London), 84: 193-9(Aug. 1964).

The quasi-spin formalism applied to identical fermions in jj coupling is known to lead to a classification of states in terms of Racah's seniority quantum number. This formalism is here generalized to include isotopic spin, and it is found that the quasi-spin operators then generate a rotation group in five dimensions. The classification that results is equivalent to that introduced by Flowers in 1952 for the configuration j^n in terms of the seniority and the reduced isotopic spin. In LS coupling with isotopic spin the quasi-spin operators appear to span a rotation group in eight dimensions. The new formalism is thought to be useful in problems involving mixed configurations in which a charge-independent pairing force is the dominant interaction. (auth)

40412 EXCHANGE OPERATORS IN SECOND QUANTIZATION FORMALISM. E. Chacon and M. de Llano (Universidad Nacional de Mexico, Mexico City). Rev. Mex. Fis., 13: 87-95(1964).

Using the representation of the generators of the U_4 group of supermultiplet theory in terms of fermion creation and annihilation operators, the exchange operators are expressed in terms of the operators of spin and isospin and of the Casimir operator of the U_4 group (or equivalently, the Casimir operator of the associated U_r group of orbital space). From these expressions, the eigenvalues for a long-range interaction with exchange follow trivially. (auth)

40413 ON THE CLASSICAL THEORY OF SINGULARITY IN NONLINEAR FIELD THEORY. A. A. Yatsenko and

S. V. Peletminskii (Khar'kov Inst. of Physics and Tech.). Ukr. Fiz. Zh., 9: 581-92(June 1964). (In Ukrainian)

On the example of a scalar field with a mass equal to zero the structures of the singularities and their movement in nonlinear theory are investigated. The question of self-excitation of the charge with uniform motion is discussed. (auth)

40414 A PROOF OF THE MANDELSTAM REPRESENTATION FOR A SIXTH-ORDER LADDER DIAGRAM. D. Ya. Petrina. Zh. Eksperim. i Teor. Fiz., 47: 524-9(Aug. 1964). (In Russian)

The Mandelstam representation for a ladder diagram of the sixth order is proven. Sufficient general conditions of validity of the representation are established. (auth)

40415 EFFECT OF MULTIPLE SCATTERING ON TRANSITION RADIATION. V. E. Pafomov (Lebedev Inst. of Physics, Moscow). Zh. Eksperim. i Teor. Fiz., 47: 530-6(Aug. 1964). (In Russian)

Transition radiation is considered by taking into account the effect of multiple scattering. Results are obtained which qualitatively describe the spectral density and total energy of the radiation related to the presence of a medium interface and which is added to the usual bremsstrahlung radiation. (auth)

40416 EXPRESSION OF THE SPECTRAL FUNCTION IN TERMS OF THE AMPLITUDE IN THE PHYSICAL REGION. V. Vaskov (Moscow State Univ.). Zh. Eksperim. i Teor. Fiz., 47: 577-80(Aug. 1964). (In Russian)

A method is described which can be used for calculating the spectral function of the double Mandelstam representation obtained by continuing the two—particle unitarity condition in the s channel in terms of derivatives of the scattering amplitude with respect to the scattering angle z for z = 0. (auth)

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Refer also to abstract 40178.

40417 (NASA-TN-D-2402) THE EFFECTS OF HIGH-ALTITUDE EXPLOSIONS. Wilmot N. Hess (National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.). Sept. 1964. 34p.

High altitude nuclear explosions have helped considerably in understanding of the natural radiation belts. The Argus artificial radiation belt made in 1958 gave information on the stability of particle orbits. The Starfish artificial belt gave quantitative information on electron lifetimes not available any other place. Below L = 1.7 the electrons have a long life and apparently are lost only by coulomb scattering on the atmosphere. Above L = 1.7 the lifetime shortens abruptly and some nonatomspheric process dominates. Synchrotron radiation and aurora were also observed after Starfish. There are some interesting questions left about how the Starfish electrons got where they did and why they have the spectra observed. (auth)

40418 ON THE THEORETICAL EFFECTS OF ELECTRODYNAMIC DRIFT IN THE EQUATORIAL F2-LAYER. Roger G. Baxter (Univ. of Sheffield, Eng.). J. Atmospheric Terrest. Phys., 26: 711-20(July 1964).

A model F2-layer in diffusive equilibrium under the influence of electrodynamic drift is considered. It is shown that there exists a critical inverse scale height g(z)/H such that all equatorial height profiles $N_0(z)$ with $[-(1/N_0)/(dN_0/dz)] > [g(z)/H]$ lead to latitude distributions of N at fixed height having a minimum at the equator. The results are applied to the study of distributions having a Chapman-like height profile at the equator. Experimental results are also used. It appears that below the peak, even small electrodynamic drifts affect the latitude distribution of the layer profoundly. The effect above the peak is less pronounced; and upward drift can, in some cases, lead to the formation of an equatorial maximum in the latitude distribution of N, where there would be a minimum in the absence of drift. The case of downward drift is also briefly considered. (auth)

40419 PERTURBATION OF A MODEL F2-REGION BY A SMALL ARBITRARY TIME-DEPENDENT ELECTRODYNAMIC DRIFT. J. E. C. Gliddon (London Univ.) and P. C. Kendall. J. Atmospheric Terrest. Phys., 26: 721-8(July 1964).

Previous studies of a model F2 region are extended to include the effects of a small electrodynamic drift. The drift is uniform in the space variable, but is an arbitrary function of time. The use of these results is illustrated by calculations carried out for a sinusoidal type of drift of variable phase. Height profiles of the perturbation are given for various phases at noon. The time variation of the perturbation at the height of maximum electron density is also given. Comparison with observations indicates that the magnitude of the vertical lunar tidal electrodynamic drift in the F2 region is about 0.4 m/sec, yielding a 3% variation of f_0F2. (auth)

40420 AURORA AND AIRGLOW INTENSITY VARIATIONS WITH TIME AND MAGNETIC ACTIVITY AT SOUTHERN HIGH LATITUDES. B. P. Sandford (Arctic Inst. of North America, Washington, D. C.). J. Atmospheric Terrest. Phys., 26: 749-69(July 1964).

A classification of nonvisual types of aurora is considered. The diurnal and seasonal variations and magnetic dependence of the intensities of the 6300, 5577, and 3914 Å emissions between auroral latitudes 50 and 90° at the time of sunspot maximum are presented. The principal source of this night sky emission is a widespread glow or "mantle" aurora, discrete auroral forms contributing only a minor fraction to the total. The intensity distributions of "mantle" aurora over the polar regions are quite different from the distributions and occurrence of discrete visual auroral forms. When diurnal variations are taken into account, the concept of the auroral and inner auroral zone has to be reconsidered. There is a permanent enhancement of 6300 Å emission in the region of the south auroral pole. (auth)

40421 SOME RELATIONS BETWEEN THE SUDDEN COMMENCEMENT IN H AND THE EQUATORIAL ELECTROJET. R. G. Rastogi, N. B. Trivedi, and N. D. Kaushika (Physical Research Lab., Ahmedabad, India). J. Atmospheric Terrest. Phys., 26: 771-6(July 1964).

The relations between the sudden commencement size and the electrojet were investigated by comparing the equatorial enhancement of the amplitude of sudden commencements during the daylight hours at stations in the American and Indian zones. (D.C.W.)

40422 ON AN IONOSPHERIC ANOMALY. A. Haubert (Centre d'Etudes Geophysiques, Garches, France). J. Atmospheric Terrest. Phys., 26: 790(July 1964). (In French)

Tonograms from the Garchy station showed that at sunrise on December 13, 1962, the F region lowered to an altitude corresponding to that of the E2 region and was then occulted by the E region, while a new F region appeared above. An explanation is proposed. (D.C.W.)

40423 INITIAL RESULTS OF THE IMP 1 MAGNETIC FIELD EXPERIMENT. Norman F. Ness, Cleil S. Scearce,

and Joseph B. Seek (Goodard Space Flight Center, Greenbelt, Md.). J. Geophys. Res., 69: 3531-69(Sept. 1, 1964).

The interplanetary monitoring platform Imp 1, or Explorer 18, launched on November 27, 1963, provided the first accurate measurements of interplanetary magnetic fields. The initial apogee of the satellite was 197,616 km on the sunlit side of the earth, with an apogee-earth-sun angle of 26°. Initial results are presented of detailed measurements of the interplanetary magnetic field and the interaction of the solar wind with the geomagnetic field. The strength of the interplanetary magnetic field is found to vary between 4 and 7 γ, with extreme values as low as 1 and as high as 10 γ. The magnitude, however, is extremely stable over times of hours, although changes of direction are significant. The average direction of the interplanetary magnetic field is slightly below the plane of the ecliptic and approximately along the streaming angle predicted for a steady-state solar wind. A significant feature of the magnetic field measurements is the discovery of fields pointed diametrically opposite the streaming angle, indicating filamentary structure of the interplanetary field. Associated with the fields of opposite direction are null surfaces between the filaments and in the over-all field structure. The complex interaction of the solar wind and the geomagnetic field shows a variety of magnetic field fluctuations and transition characteristics. The detection of the collisionless magnetohydrodynamic shock wave at $13.4R_e$ at the stagnation point associated with the super Alfvénic flow of solar plasma is one of the major results of this experiment. Details of the fluctuations are discussed, as well as the gross structure and shape of the magnetospheric surface ($10.2R_e$ at the subsolar point) and the shock wave from the subsolar point to the nighttime geomagnetic tail. The transition region between the shock wave and the magnetopause is one of high turbulence in the magnetic field. A unique aspect of the magnetic field data is the detection of the magnetohydrodynamic wake of the moon during the fifth orbit, when the satellite was eclipsed by the moon's magnetosphere while in interplanetary space. The implications of this experimental discovery are discussed. (auth)

40424 MAGNETODYNAMIC PLASMA-BEAM INSTABILITY AND GEOMAGNETIC RAPID VARIATIONS. A. Hruška (Inst. of Geophysics, Prague). J. Geophys. Res., 69: 3571-6(Sept. 1, 1964).

The magnetodynamic instability of a system consisting of a tenuous proton-electron plasma penetrating along an external magnetic field in a cool partly (or fully) ionized gas is investigated by means of the perturbation method. The criterion of instability is found. It is pointed out that this instability might play the role of a primary source of several pulsations. (auth)

40425 A STUDY OF WHISTLING ATMOSPHERICS AT DURBAN. P. A. O'Brien and N. D. Clarence (Univ. of Natal, Durban, South Africa). J. Geophys. Res., 69: 3583 (Sept. 1, 1964).

Some results of an investigation of whistling atmospherics at Durban over a two-year period are presented. Very few long whistlers were recorded. The occurrence of short whistlers at Durban is found to be correlated with the occurrence of spread F near the conjugate point. The diurnal variation of whistler occurrence is explained in terms of the diurnal variation in spread F near the conjugate point. No correlation is found between the number of whistlers recorded and the value of the magnetic K index at the time of recording. Times of peaks in whistler activity are found to follow times of peaks in magnetic activity by a mean interval of 2.2 days. (auth)

40426 ON THE DEPLETION OF IONIZATION IN THE OUTER MAGNETOSPHERE DURING MAGNETIC DISTURBANCES. K. D. Cole (Univ. of Chicago). J. Geophys. Res., 69: 3595-3601(Sept. 1, 1964).

Diffusion of plasma across a homogeneous magnetic field (B) orthogonally bounded by two conducting planes is examined. Random curl-free electric fields (E), such that $E \cdot B = 0$, consisting of fluctuations with periods greater than the time it takes to establish the magnetic field lines as equipotentials, are considered to cause the diffusion. The diffusion coefficient is $2\overline{E^2}\tau B^{-2}$, where τ is the correlation time of the random electric field and $\overline{E^2}$ its variance. Within the geomagnetic field there is a region of noisy geomagnetic fluctuations of periods in excess of 100 to 200 seconds. In this noise region diffusion changes the equatorial radial density profile from the quiet $n \propto R^{-3}$ into $n \propto R^{-4}$ (approximately). It is suggested that the diffusion explains the first-order decrease in density in the outer magnetosphere observed with whistler techniques during magnetic disturbances. In the process of diffusion caused by disturbance there is a net energization of ambient plasma sufficient to make a major contribution to the main phase of a magnetic storm. (auth)

40427 EFFECTS OF NUCLEAR EXPLOSION STARFISH PRIME OBSERVED AT HOBART, TASMANIA, JULY 9, 1962. P. J. Edwards and J. S. Reid (Univ. of Tasmania, Hobart, Australia). J. Geophys. Res., 69: 3607-12(Sept. 1, 1964).

Observations, at Hobart, Tasmania, of magnetic, ionospheric, and radiation effects of the Starfish shot are presented. The interpretation of the results is briefly discussed. Consideration of the magnitude of the ionospheric absorption that accompanied a radiation enhancement recorded by a balloon-borne Geiger counter appears to exclude atmospheric precipitation of electrons as the cause of the enhancement. (auth)

40428 MEAN DIURNAL VARIATION OF THE TOPSIDE IONOSPHERE AT MID-LATITUDES. S. J. Bauer and L. J. Blumle (Goddard Space Flight Center, Greenbelt, Md.). J. Geophys. Res., 69: 3613-18(Sept. 1, 1964).

About 500 ionograms obtained with the Alouette satellite have been used to construct the mean diurnal variation of the mid-latitude topside ionosphere. Since this diurnal variation is based on observations from October to December 1962, quasi-seasonal effects had to be removed. The data are presented in the form of electron-density contours at fixed altitudes for two latitude ranges, 35 to 40°N and 40 to 45°N. These ranges, which are approximately separated at the 75°W meridian by the 70° magnetic dip line, show remarkable differences in the detailed behavior of electron density as a function of time and altitude. From the scale heights of these mean distributions it is apparent that there is absence of thermal equilibrium, at least during the day, and that light ionic constituents become important in the altitude region from 500 to 1000 km, especially during the night. There is also the suggestion of latitude gradients in the electron temperature and mean ionic mass. (auth)

40429 POSTSUNSET RISE OF f_0F_2 AND GEOMAGNETIC ACTIVITY. Yinn-nien Huang (Ministry of Communications, Taiwan, China). J. Geophys. Res., 69: 3633-8(Sept. 1, 1964).

During the maximum epoch of sunspot cycle 19, owing to its unusually high solar activity, some anomalies in the postsunset rise of f_0F_2 at subtropical belts and the postsunset rise of h'F in the equatorial zone have been observed. The relations between the postsunset rise of f_0F_2 and h'F

and geomagnetic activity have been investigated. A possible explanation of the phenomena is also given. (auth)

40430 GEOMAGNETIC AND SOLAR DATA. J. Virginia Lincoln, ed. (National Bureau of Standards, Boulder, Colo.). J. Geophys. Res., 69: 3727-8(Sept. 1, 1964).

Geomagnetic and solar activity data are tabulated for selected days in 1962 and for all of April 1964. (T.F.H.)

40431 AN ANALOG METHOD FOR DETERMINING NEUTRON SHADOW-CONE GEOMETRY FOR HIGH-ALTITUDE NUCLEAR TESTS. E. J. Oelbermann, Jr. and J. M. Musser (HRB-Singer, State Coll., Penna.). J. Geophys. Res., 69: 3733-40(Sept. 1, 1964).

An analog method is described for studying neutron shadow-cone geometry associated with high-altitude nuclear explosions. The earth's magnetic field is assumed to be of a centered-dipole form, and the vlf and hf propagation effects outside the line-of-sight of the explosion are assumed to be produced by the decay of neutrons high in the geomagnetic field. Some results are presented. (T.F.H.)

40432 DISCUSSION OF PAPER BY E. J. STEGELMANN AND C. H. VON KENSCHITZKI, "ON THE INTERPRETATION OF THE SUDDEN COMMENCEMENT OF GEOMAGNETIC STORMS." E. N. Parker (Univ. of Chicago) and A. J. Dessler. J. Geophys. Res., 69: 3745-8 (Sept. 1, 1964).

The rise times of sudden-commencement geomagnetic storms are interpreted as being functions of the period of time taken by an enhanced solar wind to sweep over the outer boundary of the geomagnetic field, plus the difference in propagation time from different points on the boundary. The usefulness of ray-tracing techniques in connection with this study is discussed. (T.F.H.)

40433 NOTES ON SUB-ELF EMISSIONS OBSERVED DURING MAGNETIC STORMS. Lee Tepley and K. D. Amundsen (Lockheed Missiles and Space Co., Palo Alto, Calif.). J. Geophys. Res., 69: 3749-54(Sept. 1, 1964).

The spectra of atmospheric EM radiation with frequencies between 0 and 2 cps are measured. The spectra are classified as "hydromagnetic," "storm-time," and "noise-burst," and the properties of these classes are investigated. (T.F.H.)

40434 SHOCK WAVE PROPAGATION FROM A NUCLEAR BLAST. R. S. Iyengar (Mount Allison Univ., Sackville, Can.). Nature, 203: 746-7(Aug. 15, 1964).

A substantial possibility of a hydromagnetic shock propagation due to the high-altitude blast giving rise to almost instantaneous signals at different parts of the globe is pointed out. Both the impulses, one at zero time and the other two seconds later, are treated from this point of view. It is also pointed out that some of the auroral luminosity reported on this occasion might be attributed to the interaction of shock waves with the magnetosphere. (C.E.S.)

40435 IONOSPHERIC HEATING IN THE F-REGION. A. P. Willmore (London Univ.). Proc. Roy. Soc. (London), Ser. A, 281: 140-9(Aug. 25, 1964).

Measurements of electron temperature made in Ariel I have been analyzed to calculate the ionospheric energy input required to maintain the electron temperature above the ion temperature. The results are found to be consistent with the energy input due to photo-ionization in the daytime, provided that allowance is made for the effects of the escaping flux of photoelectrons spiralling upwards along the geomagnetic field lines, which impart energy to the ionosphere by electron-electron interaction. However, it is found that during the night an energy input of particle origin is observed, a close agreement being found between the distribution of energy input and that of the fluxes of low-energy particles. The particle flux contributes less than 30% to the heat input in the daytime, and its diurnal variation is small. (auth)

40436 ALTERATION OF THE ELECTRON DENSITY OF THE LOWER IONOSPHERE WITH GROUND BASED TRANSMITTERS. Pietro P. Lombardini. 25p. (CONF-630-1)

From Conference on Non-Linear Processes in the Ionosphere, Boulder, Colo., Dec. 1963.

Computational techniques as described by Carleton and Megill and Megill to calculate the difference between rate of attachment of electrons to O_2 and the ionization rate in air as a function of electric field were used to calculate the power required to create breakdown in the ionosphere. These calculations are compared with extrapolated microwave breakdown data and found to agree satisfactorily. The propagation of the primary beam is altered by the electrons created by it. This gives origin to a non-linear problem very difficult to deal with in the general case. However, a steady state approximate solution has been found, considering diffusion in one dimension. The solution is applied to the design of a possible atmospheric experiment. (auth)

Low Temperature Physics

Refer also to abstract 40120.

40437 (IS-979) SPECIFIC HEAT EVIDENCE FOR GAPLESS SUPERCONDUCTIVITY. D. K. Finnemore and F. H. Spedding (Ames Lab., Ames, Iowa). Aug. 28, 1964. Contract W-7405-eng-42. 7p. (CONF-651-4)

From 9th International Conference on Low Temperature Physics, Columbus, Ohio, Aug.-Sept. 1964. 7p.

Lanthanum doped with gadolinium (magnetic impurity) was studied to show any correlation between specific heat and gapless superconductivity. (R.E.U.)

40438 (LA-DC-6460) ISOTHERMAL FLOW OF LIQUID He II IN NARROW CHANNELS. W. E. Keller and E. F. Hammel (Los Alamos Scientific Lab., N. Mex.). [1964]. Contract W-7405-eng-36. 8p. (CONF-651-2)

From 9th International Conference on Low Temperature Physics, Columbus, Ohio, Aug.-Sept. 1964.

Super-critical velocities in flowing liquid He II were studied for narrow channels under isothermal conditions. The experimental apparatus used to observe breakdown in superfluidity is described. (R.E.U.)

40439 (LA-DC-6554) He^4 MELTING CURVE MINIMUM. S. G. Sydoriak and R. L. Mills (Los Alamos Scientific Lab., N. Mex.). [1964]. Contract W-7405-eng-36. 10p. (CONF-651-3)

From 9th International Conference on Low Temperature Physics, Columbus, Ohio, Aug.-Sept. 1964.

The entropy of melting of ^{4}He was determined quantitatively in the region 0.6 to 1.4°K. The heat capacity and thermal expansion coefficient of liquid ^{4}He were also determined for the same temperature range at just under the melting pressure. A 1000-psi BeCu Bourdon tube served as the calorimeter. (R.E.U.)

40440 (TID-21048) ELECTRONIC THERMAL CONDUCTIVITY AND OTHER PROPERTIES OF SUPERCONDUCTORS CONTAINING PARAMAGNETIC IMPURITIES. Allan Griffin and Vinay Ambegaokar (Cornell Univ., Ithaca,

N. Y. Lab. of Atomic and Solid State Physics). [1963]. Contract AT(30-1)-2179. 12p. (CONF-651-5)

From 9th International Conference on Low Temperature Physics, Columbus, Ohio, Aug.-Sept. 1964.

The decay of a heat current, a longitudinal sound wave, and the nuclear spin temperature in a superconducting alloy containing a small concentration of paramagnetic impurities were studied mathematically. (R.E.U.)

40441 AN INTRODUCTION TO HELIUM REFRIGERATORS AND LIQUEFIERS. D. E. Ward (British Oxygen Co. Ltd., London). Brit. Chem. Eng., 9: 602-9(Sept. 1964).

The application of deep low temperatures to industrial and research equipment is considered. Various cycles for producing liquid helium for refrigerators operating below 5°K are discussed, together with some of the more important design aspects. The 75 w (at 3°K) helium refrigerator being built for the helium bubble chamber of the National Institute for Research in Nuclear Sciences at Harwell is described. (auth)

40442 SUPERCONDUCTING LEVEL GAUGES: VANADIUM AND "TINNED" CONSTANTAN. B. F. Figgins, T. A. Shepherd, and J. W. Snowman (British Oxygen Co. Ltd., London). J. Sci. Instr., 41: 520(Aug. 1964).

We have developed superconducting level gages for liquid helium in which the sensitive element is a vanadium or constantan wire, the latter being coated with a superconducting material, Sn–Pb solder. These level gages have the following advantages over similar gages made of tantalum and described elsewhere: greater sensitivity; easier manufacture; and ability to operate in liquid helium under pressure (i.e., at temperatures above 4.2°K). (auth)

40443 DERIVATION OF THE GINZBURG-LANDAU THEORY FOR A LOCAL SUPERCONDUCTOR. B. Zumino (CERN, Geneva) and D. A. Uhlenbrock. Nuovo Cimento (10), 33: 1446-61(Sept. 1, 1964).

The microscopic equations for a superconductor developed earlier are expanded, in a gauge-invariant way, under the assumption that the magnetic vector potential is small and slowly varying and that the energy gap is also slowly varying. The equations obtained represent a generalization of the Ginzburg-Landau theory for a local superconductor, which should be valid at temperatures considerably lower than the critical temperature. A comparison with previous work is made, and the question of the magnetic-field-dependence of the energy gap is discussed. (auth)

40444 THE BEHAVIOUR OF TYPE II SUPERCONDUCTORS. A. M. Campbell, J. E. Evetts, and D. Dew-Hughes (Cambridge Univ., Eng.). Phil. Mag. (8), 10: 333-8(Aug. 1964).

The magnetization of irreversible type II superconductors was calculated, assuming a simple inverse proportionality between the pinning force and the magnetic induction. The effects of the spacing of the pinning centers was studied. The theory gave results in close agreement with the experimental magnetization curves for three Bi–Pb eutectic alloys, for which the critical currents were also predicted. (D.C.W.)

40445 FLUX INSTABILITIES IN HARD SUPERCONDUCTORS. J. E. Evetts, A. M. Campbell, and D. Dew-Hughes (Cambridge Univ., Eng.). Phil. Mag. (8), 10: 339-43(Aug. 1964).

Flux jumps were observed in chill-cast, Bi–Pb eutectic specimens in which fluxoid pinning is associated with small normal regions by measuring the magnetization of the specimens. The magnetization of the specimens decreased with aging. Controlled solidification changed the random Bi particle distribution, the particles becoming grouped roughly into long parallel walls. The flux trapping of the material increased, but the stability decreased. Two instability mechanisms are suggested. (D.C.W.)

40446 THE MOTION OF ABRIKOSOV VORTICES IN A TYPE II SUPERCONDUCTOR. P. H. Borcherds, C. E. Gough, W. F. Vinen, and A. C. Warren (Univ. of Birmingham, Eng.). Phil. Mag. (8), 10: 349-54(Aug. 1964).

The motion of flux into or out of a type II superconductor when the applied magnetic field changes slightly from one steady value to another was investigated. The data were analyzed assuming that flux penetration occurs through the presence of quantized Abrikosov vortices in the superconducting electron fluid and that the motion of Abrikosov vortices is related to the behavior of vortices in a classical uncharged fluid. (D.C.W.)

40447 THE λ-TYPE SPECIFIC HEAT ANOMALY IN TYPE II SUPERCONDUCTORS. B. B. Goodman (Centre de Recherches sur les Très Basses Températures, Grenoble, France). Phys. Letters, 12: 6-7(Sept. 1, 1964).

It is shown that the transition at the lower critical field is accompanied by a λ-type specific heat anomaly if the demagnetizing coefficient (n) is zero, but by a finite specific heat discontinuity if $n \neq 0$. (D.C.W.)

40448 TEMPERATURE AND MEAN FREE PATH DEPENDENCE OF THE GINZBURG-LANDAU PARAMETER. S. Gygax (Eidgenossische Technische Hochschule, Zurich) and R. H. Kropschot. Phys. Letters, 12: 7-9 (Sept. 1, 1964).

The temperature dependence of the Ginzburg-Landau parameter was determined from magnetization measurements on In–Pb alloys. The results were compared with the theory of Helfand and Werthamer and qualitatively confirmed the theoretical prediction that a shorter mean free path gives a stronger temperature dependence of the upper critical field. (D.C.W.)

40449 STRONG PHONON EFFECTS IN HIGH-TRANSITION-TEMPERATURE SUPERCONDUCTORS. A. M. Clogston (Bell Telephone Labs., Murray Hill, N. J.). Phys. Rev., 136: A8-10(Oct. 5, 1964).

The high-transition-temperature superconducting compounds V_3Ga and V_3Si have a very large electronic specific heat and strong temperature-dependent susceptibility. These properties are interpreted in terms of a large electron-phonon enhancement of the density of states, and a large exchange enhancement of the susceptibility. (auth)

40450 EFFECT OF DISSOLVED MANGANESE ON SUPERCONDUCTIVITY OF PURE AND IMPURE INDIUM. M. F. Merriam (Univ. of California, San Diego, La Jolla), S. H. Liu, and D. P. Seraphim. Phys. Rev., 136: A17-21 (Oct. 5, 1964).

The superconducting critical temperature of indium decreases by ~70°K per unit resistance ratio, $\rho_{4.2}/\rho_{273°K}$, when doped with manganese. The addition of a third element, lead or tin, (just a few per cent) progressively decreases the effect of the manganese and eliminates the effect completely when the mean free path is decreased to ~500 Å. The data are explained on the basis of the Korringa model for the resistivity-minimum phenomenon found in dilute transition-metal solutions. It is assumed that the scattering of the conduction electrons undergoes a resonance (presumably caused by the localized moments) of width ~1°K at the Fermi surface. The effect disappears when enough nonparamagnetic impurity is added to make the width of the electron energy levels large compared to that of the resonance. The technique and the model (if cor-

rect) opens a new way for investigating the resonance model for paramagnetic impurities. (auth)

40451 INTERACTION OF TRANSVERSE ACOUSTIC WAVES [$\hbar\omega \ll \epsilon_0$ (0)] WITH REAL FERMI SURFACES IN SUPERCONDUCTORS. J. R. Leibowitz (Westinghouse Research Labs., Pittsburgh). Phys. Rev., 136: A22-34 (Oct. 5, 1964).

A model is proposed which attempts to treat seemingly conflicting results obtained recently in experiments involving attenuation of transverse acoustic waves by electrons in a number of superconductors. The electron-transverse wave interaction is described in the superconducting state immediately below T_c by turning off the electromagnetic interaction within the Pippard formalism, which treats the normal state. There is obtained in this way a model for the residual superconducting attenuation by electrons which contains explicitly both the collision-drag and shear-deformation contribution. It is shown that the interaction with shear waves in the superconducting state is reduced to a simple form when $q\ell \gg 1$, so that it is possible to study the shear-deformation tensor in a rather direct way; the superconducting shear-wave electronic attenuation for $q\ell \gg 1$ is found to reduce to the same form as the corresponding normal-state compressional-wave attenuation. The model is applied in an examination of general features of experimental data on tin, aluminum, gallium, and some transition metals. In application of the model to aluminum, for the case of a given propagation orientation, Fermi surface deformation is found to account for roughly 10% of the total electronic interaction at low temperatures. Finally, the form obtained for the shear-deformation contribution to the residual attenuation is shown to suggest the applicability of the Bardeen, Cooper, Schrieffer relation to the case of superconducting transverse-wave residual attenuation when $q\ell \gg 1$. (auth)

40452 MAGNETIC-FIELD DEPENDENCE OF MICROWAVE ABSORPTION AND ENERGY GAP IN SUPERCONDUCTING FILMS. R. H. White and M. Tinkham (Univ. of California, Berkeley). Phys. Rev., 136: A203-17(Oct. 5, 1964).

The change in absorption of microwave radiation by superconducting indium, tin, and lead films was measured as a function of magnetic field. Experiments were conducted on films 145 to 700 Å thick using 8- and 4-mm-wavelength microwave radiation, primarily with the magnetic field parallel to the plane of the film, but also as a function of angle between the magnetic field and the plane of the film. A second-order phase change was observed in the magnetic field, as is to be expected for films of this thickness according to the theories of Ginzburg and Landau and of Nambu and Tuan. The angular dependence of the critical field found in the measurements is in good agreement with the theory of one of the authors, which predicts an angular dependence given by the formula $(H_c \sin\theta/H_{c\perp}) + (H_c \cos\theta/H_{c\parallel})^2 = 1$. An attempt was made to infer the magnetic-field dependence of the effective energy gap Δ from the absorption measurements in a parallel magnetic field. This inference was made by using the calculations of Miller, based on the theory of Mattis and Bardeen. The magnetic-field dependence of Δ is not in agreement with previous experiment and theory, as Δ decreases much more rapidly in low magnetic fields in the experiments, nor is it completely consistent for the two frequencies used. Thus, it appears from the experimental absorption measurements that the effect of a magnetic field on a superconducting film cannot be adequately described simply by introducing a field-dependent energy-gap parameter. (auth)

40453 1s–2p TRANSITION OF H AND D IN SOLID ARGON. Giancarlo Baldini (Univ. of Rochester, N. Y.). Phys. Rev., 136: A248-51(Oct. 5, 1964).

The 1s–2p transition of hydrogen and deuterium atoms diluted in solid inert gases was observed and its energy and half-width measured. In argon, absorption occurs at the energies of 10.55 and 10.565 ev and the half-widths are 0.27 and 0.23 ev, respectively, for H and D. An analysis of these results leads to an estimate of the frequency of a localized vibrational mode associated with the H and D impurities. (auth)

40454 EXCITED STATES OF SOLID Ar:H. Thomas H. Keil and Albert Gold (Univ. of Rochester, N. Y.). Phys. Rev., 136: A252-4(Oct. 5, 1964).

Excitation energies for the 1s–2p and 1s–2s transitions of a hydrogen atom as a substitutional impurity in solid argon were calculated as a function of nearest-neighbor distance. A tight-binding treatment using Schmidt-orthogonalized wave functions is used to obtain the first-order shift from the atomic absorption energies. Overlap of atomic wave functions is taken into account through terms of second order, and three-center contributions are evaluated explicitly. The additional changes in the energies due to van der Waals interactions are obtained by a variational technique. Excitation energies for the 1s–2p and 1s–2s transitions are found to be 10.6 ± 0.2 and 12.3 ± 0.2 ev, respectively, for a nearest-neighbor distance of $7.0a_0$. The former gives good agreement with recent experimental observations. (auth)

40455 EFFECTS OF ELECTRON CONCENTRATION AND MEAN FREE PATH ON THE SUPERCONDUCTING TRANSITION TEMPERATURES OF ZINC ALLOYS. D. Farrell, J. G. Park, and B. R. Coles (Imperial Coll. of Science and Tech., London). Phys. Rev. Letters, 13: 328-30(Sept. 7, 1964).

The transition temperature T_c of dilute alloys based on zinc was investigated. A strong dependence of T_c on mean free path was found, while, at constant mean free path, T_c varied rapidly with electron concentration X. The variation of T_c with X was calculated rather well by a simple model. (D.C.W.)

40456 POSSIBILITY OF ONE-DIMENSIONAL SUPERCONDUCTIVITY. Richard A. Ferrell (Univ. of California, Berkeley). Phys. Rev. Letters, 13: 330-2(Sept. 7, 1964).

It is shown that the compressional modes of vibration are much more dominant in one dimension than in three dimensions and prevent the establishment of the long-range lattice order required for superconductivity. (D.C.W.)

40457 SPECIFIC HEAT OF TYPE II SUPERCONDUCTORS IN A MAGNETIC FIELD. T. McConville and B. Serin (Rutgers Univ., New Brunswick, N. J.). Phys. Rev. Letters, 13: 365-7(Sept. 21, 1964).

The specific heats of Nb, In–Bi, and Nb–Ta are measured in a constant magnetic field as a function of temperature. The magnetic field is chosen such that it corresponds to both the upper and lower critical fields of the samples as the temperature varies. As the temperature increases, the heat capacity exhibits a very large peak, followed by a discontinuous drop. The results suggest that there is a marked difference between the behavior of "clean" and "dirty" type II superconductors. (T.F.H.)

40458 THE MAGNETIC PROPERTIES OF SUPERCONDUCTING ALLOYS. [PART] I. Kazumi Maki (Kyoto Univ.). Physics, 1: 21-30(July-Aug. 1964).

The general Ginzburg-Landau equation valid for all

temperatures is derived from the microscopic theory for superconducting alloys where the electronic mean free path 1 is much shorter than the coherence length ξ_0. Using this equation the magnetic properties of Abrikosov's mixed state as well as the temperature dependence of the upper critical field H_{c2} are discussed. It is shown that the Abrikosov structure in the vicinity of the transition point is completely characterized by two parameters $\kappa_1(T)$ and $\kappa_2(T)$, both of which coincide at the critical temperature with κ, the Ginzburg-Landau parameter. A peculiar deviation in the thermodynamical behavior at lower temperatures from Abrikosov's theory is found for superconductors with $\kappa = 1/\sqrt{2}$. (auth)

40459 MEASUREMENT OF THE LIQUID—CRYSTAL EQUILIBRIUM DIAGRAM FOR HELIUM ISOTOPE SOLUTIONS. I. V. Bogoyavlenskii, N. G. Bereznyak, and B. N. Eselson (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Zh. Eksperim. i Teor. Fiz., 47: 480-3 (Aug. 1964). (In Russian)

The curves of the beginning and end of solidification of ^3He–^4He solutions containing 53.6 or 76.5% ^3He are measured in the 1.4 to 4.0°K temperature range. In this way the width of the stratification region on transition from the liquid to solid state of the solutions can be determined throughout the whole concentration range. The triple points connected with polymorphic transition to the solid state were also measured for the solutions. An equilibrium diagram for the liquid and solid states of the ^3He–^4He system is constructed which, in the 50 to 140 atm range, is a diagram of the peritectic type. (auth)

40460 SURFACE TENSION OF PARA-HYDROGEN. V. N. Grigorev (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Zh. Eksperim. i Teor. Fiz., 47: 484-5(Aug. 1964). (In Russian)

The surface tension of para-hydrogen is measured between 17 and 20.5°K. It is found to be (1.5–2)% less than that of ordinary hydrogen. (auth)

40461 REFLECTION AND TRANSFORMATION OF SOUND WAVES INCIDENT ON THE VAPOR-LIQUID He II BOUNDARY. D. M. Chernikova (Moscow Inst. of Physics and Tech.). Zh. Eksperim. i Teor. Fiz., 47: 537-42(Aug. 1964). (In Russian)

Transformation and reflection of sound waves incident on the vapor–liquid He II boundary are considered. The general form of the boundary conditions is found, and the transformation and reflection coefficients for sound waves are determined. It is shown that second sound and sound propagating in vapor are mutually transformable whereas practically no transformation of first sound into second or into sound in vapor or transformation of the latter two types of sound into the first occurs. (auth)

40462 ON SURFACE SUPERCONDUCTIVITY IN STRONG MAGNETIC FIELDS. A. A. Abrikosov (Inst. of Problems in Physics, Academy of Sciences, USSR). Zh. Eksperim. i Teor. Fiz., 47: 720-33(Aug. 1964). (In Russian)

Surface superconductivity in fields exceeding the critical field strength H_{c2} is considered. It is shown that the phenomenon exists at all temperatures below T_c. The critical field strength in thin films located in a parallel field is determined, and the field strength dependence of the critical current of surface superconductivity of a massive sample is derived. (auth)

40463 THE 1962 ^3He SCALE OF TEMPERATURES. T. R. Roberts (Los Alamos Scientific Lab., N. Mex.), R. H. Sherman, S. G. Sydoriak, and F. G. Brickwedde. p.480-514 of "Progress in Low Temperature Physics." Amsterdam, North-Holland Publishing Co., 1964. (LADC-5757)

A scale on which temperatures from 0.25°K to the critical temperature of ^3He (3.324°K) are defined by the vapor pressure of pure liquid ^3He in equilibrium with pure ^3He vapor at the temperature in question is discussed. (C.E.S.)

Neutron Physics

Refer also to abstracts 40529, 40744, 40798, and 40800.

40464 (AAEC/E-117) INTEGRALS INVOLVING DOPPLER-BROADENED CONTOUR FUNCTIONS. B. E. Clancy and A. Keane (Australia. Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales). Mar. 1964. 22p.

A variety of integrals arising in the study of resonance absorption were evaluated. (auth)

40465 (AE-148) A CALCULATION OF THE ANGULAR MOMENTS OF THE KERNEL FOR A MONATOMIC GAS SCATTERER. Rune Håkansson (Aktiebolaget Atomenergi, Stockholm). July 1964. 16p. (UDC-539-125-523).

The first four moments of the scattering kernel are obtained for a monatomic gas, assuming isotropic scattering in the cms. Numerical results are given for masses M = 1 and 3.6. (R.E.U.)

40466 (APED-4342) SPATIAL EXPANSION OF THE TRANSPORT EQUATION. G. C. Pomraning and M. Clark, Jr. (General Electric Co. Vallecitos Atomic Lab., Pleasanton, Calif.). Mar. 25, 1964. 39p. (63-APE-16)

The solution of the monoenergetic transport equation in slab geometry is expanded in terms of known spatial functions and unknown angular coefficients. Two general formalisms, a variational method and a moment conservation method, are developed to obtain the necessary equations for the angular coefficients. The latter formalism is emphasized since it always yields neutron conservation. Further, it is shown that this formalism treats exactly any incident flux boundary condition, including the discontinuous vacuum boundary condition. For small systems with a highly peaked directional flux, a spatial expansion of the directional flux in integer powers of z (the spatial coordinate) is shown to yield extremely good results. Thus a polynomial expansion forms a complement to the widely used angular expansions, such as the P-N (spherical harmonic) method, which are most accurate for large systems with an almost isotropic directional flux. To emphasize the fact that the formalisms developed are applicable to any spatial expansion functions, the penetration (of a normal beam) problem is considered with exponential expansion functions. The analysis is shown to reduce to the exact transport result in all known limits. (auth)

40467 (BNL-7842) TIME EIGENVALUES AND DEGENERATE KERNELS IN THERMALIZATION. Noel Corngold and Charles S. Shapiro (Brookhaven National Lab., Upton, N. Y.). Feb. 1964. Contract AT-30-2-GEN-16. 6p. (CONF-446-24)

From American Nuclear Society 10th Annual Meeting, Philadelphia, June 1964.

Neutron thermalization in a gas was calculated for the free-gas model and for the heavy crystal model. The use of a synthetic degenerate kernel was also studied. (R.E.U.)

40468 (EUR-1643.e(p.115-18)) MONTE CARLO STUDIES OF NEUTRON TRANSPORT PROBLEMS IN THE

FAST- AND INTERMEDIATE-ENERGY REGION. H. Rief (European Atomic Energy Community. Joint Nuclear Research Center, Ispra, Italy).

The MOCA II code for IBM 7090 was used to make a number of calculations of considerable theoretical interest. A few characteristic examples are given here to illustrate the wide field of applicability of the code, which uses Monte Carlo methods. (auth)

40469 (EUR-1643.e(p.119-23)) MULTIPLE COLLISION METHOD FOR NEUTRON TRANSPORT PROBLEMS. T. Asaoka (European Atomic Energy Community. Joint Nuclear Research Center, Ispra, Italy).

The multiple collision method, which is based on the random walk approach, is described, and examples of its use are given. Neutron transport in an infinite homogeneous slab of finite thickness, neutron distributions in a critical slab, and critical calculations for a bare sphere are considered. The method provides for discontinuities caused by the finiteness of the system. (R.E.U.)

40470 (EUR-1643.e(p.125-30)) THEORY OF STATISTICAL FLUCTUATIONS IN NEUTRON FIELDS. W. Matthes (European Atomic Energy Community. Joint Nuclear Research Center, Ispra, Italy).

The theory of statistical fluctuations without approximations is developed. The Boltzmann and Chapmann-Kolmogoroff equations are considered. (R.E.U.)

40471 (EUR-1643.e(p.131-6)) NEUTRON CORRELATION EXPERIMENTS ON MODERATORS. R. Haas and B. Weckermann (European Atomic Energy Community. Joint Nuclear Research Center, Ispra, Italy).

Time-dependent thermalization of neutrons in moderating materials was studied using correlation function measurements. Specific interest was given to paraffin using a two-detector method. (R.E.U.)

40472 (EUR-1643.e(p.137-41)) A WAVE MODEL FOR NEUTRON MIGRATION. K. H. Mueller (European Atomic Energy Community. Joint Nuclear Research Center, Ispra, Italy).

The expansion of neutron waves was investigated in P_1 approximation to obtain information on the dynamic behavior of pulsed assemblies. (R.E.U.)

40473 (EUR-1643.e(p.143-54)) NEUTRON THERMALIZATION STUDIES. V. Ardente, H. Hembd, A. Kind, and G. Rossi (European Atomic Energy Community. Joint Nuclear Research Center, Ispra, Italy).

The interactions between slow neutrons and molecules and crystals were studied mainly with reference to the polyphenyls. The first aim was to clarify the influence on the scattering quantities of the various individual features of the molecular dynamics (vibrations, rotations, translations). In a preliminary analysis of the benzene molecule, some conclusions on the models and on the possibility of extending them to the polyphenyls were drawn with reference to the experimental results as given by the bound-proton total scattering cross section measurements. Investigations on the space-energy distribution of thermal neutrons in reactor lattices were carried out in order to provide a simple but physically sound method for systematic calculations, and subsequently to obtain a reliable numerical method for a more refined analysis concerning particular space-energy effects and for checking the simplified models. With the aid of the latter, an extensive analysis of the influence of the scattering model on the space-energy distribution of the thermal neutrons in the CANDU type lattices is now under way. (auth)

40474 (IDO-16977(p.23-43)) NUCLEAR PHYSICS. (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho).

A sample of ^{233}Pa was prepared in a form for use in the MTR fast chopper to determine the total cross section as a function of energy. The sample consisted of 787.6 mg of $^{233}Pa_2O_5$ (14,000 Curies); the cross section at thermal energy was measured. Measurements of eta for ^{233}U and ^{239}Pu were completed for incident neutron energies of 0.057 ev; the values obtained were 2.296 and 2.041 for ^{233}U and ^{239}Pu respectively. The half life of the longer ^{166}Ho isomer was determined to be 1200 ± 150 years, based upon mass analysis of a highly irradiated Ho sample coupled with measurement of the absolute disintegration rate of the ^{166}Ho. The Placzek first moment condition has been calculated for the available scattering law data to see if any of the data obey it. The elastic scattering from powdered beryllium has been measured and shows the expected structure. The scattering profiles from gaseous, liquid, and solid ammonia show the effect of rotations, hindered rotations, and crystalline binding. Fits to the water scattering data were obtained with a theory that assumed that five types of water molecules existed, each type in cluster. A program has been written for the scattering of slow neutrons from CH_4 and CD_4. The CD_4 results show the pronounced effects of coherent scattering. Mathematical analysis shows that in the one-ev-and-above range Doppler broadening is insensitive to the model used. Work included an attempt to observe gamma spectra of ^{178}Yb and ^{162}Gd. No evidence of these nuclides was indicated. Branching ratios and internal conversion coefficients for the 145-kev transition in the decay of ^{141}Ce are reported. The thermal-neutron activation cross section for ^{54}Mn has been measured and a value reported. (auth)

40475 (JUL-160-NP) ON THE DETERMINATION OF THE DIFFUSION CONSTANTS OF H_2O, PHENYLS, $ZrH_{1,26}$, AND D_2O BY NEUTRON SINGLE-SCATTERING EXPERIMENTS. T. Springer (Kernforschungsanlage, Jülich, Germany); Ch. Hofmeyr, S. Kornbichler, and H. D. Lemmel (Munich. Technische Hochschule). May 1964. 35p.

The average thermal diffusion constant $\langle Dv \rangle$ is usually determined by integral methods. i.e., by investigating the relaxation of the neutron density in time or in space. A different approach was used in this study. From measurements of the differential scattering cross section $d\sigma(\theta)/d\Omega$ for various neutron energies E and sample temperatures T_m, the average cosine of the scattering angle $\bar{\mu}$. the diffusion constant $D(E, T_m)$, and its thermal average $\langle Dv \rangle_{T_m}$ was calculated. Investigations were performed on the most important hydrogeneous moderators and on D_2O. It was found that the scattering cross sections $d\delta/d\Omega$ are not very sensitive to the temperature. Therefore, the quantity $\langle Dv \rangle$ can easily be evaluated within a large temperature range by means of a comparatively small number of $d\delta/d\Omega$ measurements. A qualitative explanation of the very strong interference maxima in the $d\delta/d\Omega$ curves of D_2O can be given. Rather strong coherence maxima were observed in the phenyl and ZrH curves, too. Very good agreement was obtained between this $\langle Dv \rangle$ data and the results of conventional relaxation experiments both with light and heavy water. There was also good agreement with theoretical predictions for H_2O, D_2O, diphenyl, and reasonable agreement with calculations for $ZrH_{1,26}$. For diphenyl, there was agreement with some of the relaxation experiments cited in literature. The consistency of the results shows that these thermal diffusion param-

eters ⟨Dv⟩ as a function of T_m and the diffusion constant D as a function of E can be considered as reliable for one- or multigroup calculations. (auth)

40476 (NAA-SR-9503) THE AGE OF FISSION NEUTRONS TO INDIUM RESONANCE ENERGY IN ZIRCONIUM–WATER MIXTURES. R. K. Paschall (Atomics International, Div. of North American Aviation, Inc., Canoga Park, Calif.). Sept. 15, 1964. Contract AT(11-1)-Gen-8. 44p.

The age of fission neutrons to indium resonance energy (1.46 ev) was measured in mixtures of zirconium and water. Three different volume ratios of metal-to-water were investigated. The experimental technique of a finite plane fission source with essentially infinite plane detectors was used (equivalent to using an infinite plane source with axial detectors). Thus, the theoretical corrections to the measured results were only 1.5% or less. This is the same technique used previously at this laboratory to measure the age in pure water, and comparisons were made with those data. The results indicate a linear variation of the age as a function of metal-to-water ratio. From these experiments, $\tau(cm^2) = 26.63 + 19.23R$ for $0.00 \leq R \leq 1.20$, where R is the metal-to-water volume ratio. (auth)

40477 (NAA-SR-Memo-9802) IMPROVEMENTS TO THE TYCHE MOMENTS CODE AND OPERATING INSTRUCTIONS FOR TYCHE III. R. A. Blaine (Atomics International, Div. of North American Aviation, Inc., Canoga Park, Calif.). May 1964. Contract [AT(11-1)-Gen-8]. 52p.

TYCHE III is a revision of the TYCHE code which computes the second, fourth, and sixth moments of the neutron slowing down distribution in infinite media. Improvements have been made in the treatment of cross sections; graphical displays are provided in order to observe the rate of convergence; and a restart option is available. (auth)

40478 (RM-4120-AEC) NEUTRON FLUXES FROM A VERTICALLY COLLIMATED SOURCE OF 14 Mev NEUTRONS AT AN AIR-GROUND INTERFACE. J. I. Marcum (RAND Corp., Santa Monica, Calif.). Aug. 1964. Contract AT(04-3)-414. 23p.

Results are given for the flux and dosage from a vertically collimated upward-pointing source of 14 Mev neutrons at a simulated air-ground interface. The solutions were obtained by the use of the RAND Monte Carlo Neutron Transport Code, and are presented in such a way that they can easily be compared to results previously obtained for an isotropic point source. (auth)

40479 SPACE-ENERGY DISTRIBUTION OF NEUTRONS IN A HOMOGENEOUS MODERATOR. D. A. Kozhevnikov. At. Energ. (USSR), 17: 34-44(July 1964). (In Russian)

The process of neutron thermalization in a homogeneous medium of arbitrary isotopic composition is studied by the method of spherical harmonics. The dependence of the line of free flight of neutrons on the lethargy is considered approximately. For small scattering from the source, the distribution function does not depend on the order of approximation of the spherical-harmonic method and decreases as a result of the age approximation, for which the limits of applicability are estimated. For large scattering, the spatial dependence of the distribution function is completely determined by the spatial distribution of the primary neutrons, and the angular distribution and energy spectrum of the slow neutrons do not depend on the coordinates. Results of calculations of the spatial distribution of indium neutrons in water are presented for monoenergetic and full-energy sources. (tr-auth)

40480 PENETRATION OF NEUTRONS THROUGH CARBON AND IRON–CARBON MIXTURE. V. K. Daruga, I. I. Lazutkin, A. N. Nikolaev, V. K. Sakharov, B. I. Sinitsyn, and S. G. Tsypin. At. Energ. (USSR), 17: 60-3 (July 1964). (In Russian)

A study was made of the spatial distributions of neutrons of various energies traveling through carbon of thickness 10 to 150 cm and through alternating layers of C and Fe, where Fe was 37.4% of the total volume. The BR-5 reactor was used for the neutron source. The characteristics of the six detectors used—^{27}Al, ^{32}S, ^{232}Th, ^{63}Cu, ^{115}In, and proportional—are tabulated. The experimental data were fitted to a neutron attenuation function for an infinite plane monodirectional source; resulting graphs for both media are given for various energy groups and detectors. Results of calculations and measurements of relaxation lengths are presented. (M.J.T.)

40481 A HEAVY-CURRENT HIGH-VOLTAGE SOURCE FOR A NEUTRON GENERATOR. H. Beine (Kernphysikalisches Institut, Deutsche Akademie der Wissenschaften zu Berlin, Zeuthen b. Berlin) and A. Peil. Exptl. Tech. Physik, 12: 113-15(1964). (In German)

The high-voltage generator for the particle accelerator at the Institute of Nuclear Physics at the German Academy of Sciences is described, comprising a line transformer, a control transformer, and a rectifier. Charging capacitors of 0.04 μF are designed for a 300-kv operating voltage. The voltage drop with ideal rectifiers is 1 kv with a 2-mamp load. Insulation and corona losses are negligible. The line transformer is rated at 8 kv-amp and can supply a maximum of 100 kv effective. The control transformer is rated at 0 to 220 v and 10 amp. (auth)

40482 ON THE PROBLEM OF THE ENERGY-DEPENDENT ISOTROPIC TRANSPORT EQUATION FOR A PLANE SLAB. K. Fuchs and S. Collatz (Zentralinstitut für Kernforschung, Rossendorf, Ger.). Kernenergie, 7: 386-91(June-July 1964).

The problem of isotropic, energy dependent neutron transport in a homogeneous, one-dimensional plane slab was reduced in principle by expansion in the eigenfunctions of the transport equation to the successive solution of two integral equations of the Fredholm type. The system of eigenfunctions of the transport equation, the finite slab, and special cases are discussed. Other fundamental problems of reactor theory, such as Milne's problem, the albedo problem, and Green's problem, can also be treated by means of the method presented. (auth)

40483 INVESTIGATION OF THE FILTER-HARDENED THERMAL NEUTRON SPECTRUM IN A SPHERE OF NATURAL-URANIUM BY MEANS OF NON-1/v FOILS. D. Albert (Zentralinstitut für Kernforschung, Rossendorf, Ger.). Kernenergie, 7: 397-401(June-July 1964).

Thermal neutron spectra that substantially deviate from the Maxwellian form owing to strong spectrum hardening were investigated by means of the foil method and these deviations were taken into account by an additional spectrum parameter. By means of activation measurements using thin Lu, Eu, and Au foils two parameters of the thermal neutron spectrum were determined. The spectrum inside a 6-cm diameter natural uranium sphere was found to deviate significantly from the Maxwellian distribution. The applicability of the method described is suitable, in addition to measurement of spatial distributions of neutron temperature, for obtaining integral statements for details in strongly hardened thermal neutron spectra. (auth)

40484 AN EASILY REGENERABLE (Sb–Be) NEUTRON SOURCE. János Toerko. Magy. Kem. Lapja, 19: 299(June 1964). (In Hungarian)

An easily regenerable neutron source was designed. The construction outlined enables the easy reassembling of the source and the repeated reactivation as well. (auth)

40485 P_N CALCULATIONS. G. R. Dalton (Univ. of Florida, Gainesville). Nucl. Sci. Eng., 20: 131-7(Oct. 1964).

A method of doing P_N calculations which is particularly useful for classroom use is presented. The method is basically a systematic numerical implementation of the analytic method of characteristic solutions. The extensive tabulations of characteristic roots are used as guide lines for the solution of the characteristic (N + 1) order polynomial equation. Then the tables of coupling coefficients are used to guide the evaluation of the coupling or recursion relations. The systematics of matrix algebra are next used to set up the linear equations resulting from the boundary conditions and to reconstruct the angular moments and the angular fluxes. The use of these tabulated guide lines and matrix operations to provide the single and double summations reduces the problem to a very manageable level. A sample P_3 problem treated in this manner is presented. (auth)

40486 AN ABSOLUTE THERMAL-NEUTRON-FLUX STANDARD. R. G. Cochran, D. E. Feltz, J. D. Randall, and J. V. Walker (Agriculture and Mechanical Coll. of Texas, College Station). Nucl. Sci. Eng., 20: 138-41(Oct. 1964).

A useful and inexpensive assembly for thermal-neutron-flux standardization is described. This assembly consists of a water filled tank containing three Pu–Be neutron sources, each located at an apex of an equilateral triangle with sides of 5.6 inches and appropriately centered in the tank. The thermal flux is spatially invariant and isotropic over a rather large region in the test section and thus reduces the effects of positioning errors of foils and detectors being calibrated. Methods for standardizing such an assembly are discussed. (auth)

40487 MEASUREMENT OF RESONANCE ESCAPE PROBABILITY OF UO_2–ThO_2 MIXTURES. Horst Muenster (Johann Wolfgang Goethe-Universität, Frankfurt am Main and Allgemeinen Elektricitäts-Gesellschaft, Frankfurt am Main). Nukleonik, 6: 168-74(July 1964). (In German)

An experiment is described which allows a determination of the effective resonance absorption integral and the resonance escape probability of UO_2–ThO_2 rods. The results of measurements obtained by an activation method were based on the resonance integral of gold as a standard. A comparison with the results of other authors shows that the measurements do not differ within the limit of error for pure UO_2. For pure ThO_2, discrepancies occur, which are discussed individually. For UO_2–ThO_2 mixture, good qualitative agreement with the theoretically determined values of Crowther was found. (tr-auth)

40488 A GENERALIZED GALERKIN METHOD FOR NUMERICAL SOLUTION OF THE NEUTRON TRANSPORT EQUATION. Reimar Froehlich (Interatom GmbH, Bensberg, Ger.). Nukleonik, 6: 211-17(July 1964). (In German)

It is shown that the solution to the monoenergetic neutron transport equation in the case of two-dimensional geometry and isotropic distribution reduces to the solution of an uncoupled system of diffusion equations in an arbitrarily good approximation. For this generalized Galerkin method, error estimations were deduced with the help of functional-analytical analysis, which allows on one hand the errors between the obtained approximation equation and the exact solution of the neutron transport equation to be evaluated, and which makes it possible to furnish evidence of convergence. The method is compared with a well-known numerical method. (L.B.S.)

40489 NEUTRON PHYSICS CONSIDERATIONS IN LARGE FAST REACTORS. David Okrent (Argonne National Lab., Ill.). Power Reactor Technol., 7: No. 2, 107-37(Spring 1964).

The steady-state nuclear characteristics of large fast power reactors are reviewed. Information is given on: the important cross sections of the major fissile and fertile isotopes in relation to neutron energy spectrum in typical fast reactors; performance-related characteristics, such as breeding ratio, critical mass, and long-term reactivity changes, as functions of reactor size and composition; safety-related characteristics, namely, the reactivity coefficients; and design variables and considerations in relation to these neutron physics characteristics. Included among topics treated are hybrid fuel systems and the relative nuclear performance of various cladding and structural materials. The relative reactivity worth and breeding potential of the various isotopes are explained in terms of cross sections. 66 references. (N.W.R.)

40490 THERMAL-NEUTRON DIFFUSION PARAMETERS. Power Reactor Technol., 7: No. 2, 145-53(Spring 1964).

Information pertaining to the measurement and calculation of thermal diffusion parameters is reviewed. Comparisons are given of the diffusion parameters in water, heavy water, graphite, and other media. 21 references. (N.W.R.)

40491 INSTALLATION USING A Ra–Be NEUTRON SOURCE WITH AN ACTIVITY OF 238 mc Ra. S. Kwiecinski (Gorniczo-Hutnicza Academy, Krakow). Symp. Tech. Zagadnien Ochrony Promieniowaniem, Warsaw, 746-51 (1962). (In Polish)

An installation with a Ra–Be neutron source with an activity of 238 mc Ra for activation and neutron analytical work is described. The work planned with such a source assumed 6 to 8 hrs daily residence in the vicinity of the source (1 m distance) and repeated manipulation during the day. Directly over the installation (3 m distance) was the administration room of the institution. The installation itself was in the air raid shelter. The mechanism was specially constructed of easily movable concrete box shields to give free manipulation of the source. The dose output distribution at various points of the shielding, the laboratory, and adjacent rooms was determined for two cases: in the working and rest state (the source lowered into an earthen box 2.5 m deep). (tr-auth)

40492 ISSLEDOVANIYA PO NEITRONNOI FIZIKE. (Investigations of Neutron Physics). D. V. Skobel'tsyn, ed. Tr. Fiz. Inst., Akad. Nauk SSSR, 24: 1-262(1964).

Six articles are included on neutron physics, nonstationary neutron moderation in heavy media, radiative capture of neutrons to 50 kev, and slow neutron reactions. A separate abstract was prepared for each article. (R.V.J.)

For abstracts of individual papers see: 40493, 40494, 40495, 40496, 40630, and 40631.

40493 STUDIES OF PHYSICS OF SLOW NEUTRONS. F. L. Shapiro. Tr. Fiz. Inst., Akad. Nauk SSSR, 24: 3-67 (1964). (In Russian)

Pulsed neutron techniques are described for determining

the slowdown of neutrons in a Pb prism. The pulse neutron generator gives 14-mev neutrons with a peak intensity of 5×10^{11} neutrons/sec. The neutron pulse lasts a minimum of 0.5 μsec, and the pulse frequency is 1250 cycles/sec. The capture gamma-rays were counted with a proportional counter or a scintillation counter having a CaF_2 crystal. Neutrons were counted with chambers of different construction containing BF_3, ^3He, ^{14}N, or thin layers of boron, ^6LiF, or uranium. Time analysis of the pulses was carried out on a multi- or single-channel analyzer. The theory treats the neutron density in a heavy medium such as Pb as a function of the time of slowing down. The distribution of neutron velocities is calculated. Experiment shows that the average time of slowing down is related to the neutron energy in Pb as follows: $\bar{t} = 13.5\ E^{0.5} - 0.3$, where $\bar{t}$ is in μsec, and E is in kev. The dispersion in slowdown time is 60% greater than expected for pure lead and is due to a hydrogen impurity of 4×10^{-4} atoms per atom of Pb and to an oxygen impurity of 6×10^{-3} atoms per atom of Pb. The diffusion constants of Be and graphite were found to be 1.17 and 2.07×10^{-5} cm^2/sec respectively. The thermalization times were 165 ± 30 μsec for graphite and 110 ± 40 μsec for Be. The slowing-down time was used to measure the energy dependence of (n,γ) reactions in Cl, Fe, Rh and In. Also, the energy dependence was obtained for the cross sections of the $^6Li(n,\alpha)$, $^{10}B(n,\alpha)$ and the $^{14}N(n,p)$ reactions. (108 references). (TTT)

40494 EXPERIMENTAL INVESTIGATIONS OF NONSTATIONARY NEUTRON THERMALIZATION IN HEAVY MEDIA. A. I. Isakov. Tr. Fiz. Inst., Akad. Nauk SSSR, 24: 68-110(1964). (In Russian)

The $T(d,n)^4He$ reaction was used to produce 14-Mev neutron bursts in a Pb prism weighing 110 tons. A gamma count I_γ was taken on samples of La_2O_3, Se, Au, and Ir which have isolated resonance levels and was compared with the neutron count. Plots of I_γ/I_{Li} versus the slowing-down time t in μsec show resonances at $E_0 = 74.5$ ev for La, $E_0 = 27$ ev for Se, $E_0 = 4.906$ ev for Au, and $E_0 = 1.303$ and 0.657 ev for Ir. The half-widths of the resonance peaks were determined, and corrections were applied for thermal motion and chemical bonding. The average lifetime of neutrons in Pb was found to be 890 ± 40 μsec. Similar experiments were run in an iron prism having dimensions of $1.2 \times 1 \times 1$ m^3. Using the 4.906-ev resonance level in Au, a plot of I_γ/I_B showed that the average neutron slowing-down time was $\bar{t} = 21.7$, which agreed well with a calculated value of 21.8 μsec. Measurements were also carried out in a graphite prism $330 \times 120 \times 70$ cm^3. The zirconium-tritium neutron source was placed at the center of the prism and the neutron and gamma-detectors were placed at various distances from the neutron source. Using a gold sample, it was found that the average slowing-down time (from 14 Mev to 4.906 ev) was 11.5 ± 0.2 μsec. The form of the absorption line for gold agrees with the theoretical shape. These measurements in graphite, iron and Pb confirm the correctness of the conclusions of the theory of nonstationary, elastic slowing down of neutrons. (TTT)

40495 ON CERTAIN PECULIARITIES OF ELASTIC NEUTRON THERMALIZATION. I. M. Frank. Tr. Fiz. Inst., Akad. Nauk SSSR, 24: 203-11(1964). (In Russian)

A method is given for calculating the square of the neutron velocity deviation from the average velocity. An average loss in velocity with each elastic collision is assumed, and it is found that $t = (m'\lambda/v) - t_0$ and $t_0 = (m'\lambda/v_0)$. Here t is the slowing-down time; $m' = f(m)$, where m is the atomic weight of the moderator; λ is the average scattering length; and v is the neutron velocity. Neutron spectrometry from the slowing-down time is based on this relation. On determining the role of fluctuations in the number of collisions, it is found that $d/dt\ (\overline{\Delta v^2}/v^2)_{statis.} = (4v/3(m')^2\lambda)$. The value of $(\overline{\Delta v^2}/v^2)$ is positive. Since the change in neutron velocity is proportional to v^2, the average velocity does not depend on v_0; and two neutrons having different initial velocities have practically the same final average velocity after a sufficiently long slowing-down time. The instantaneous neutron spectrum tends to a stationary distribution, where $(\overline{\Delta v^2}/v^2) = (2/3m')$. If the slowing down of neutrons takes place in a heavy medium such as Pb, the value of $(\overline{\Delta v^2}/v^2)$ will be very sensitive to the presence of small amounts of light impurities such as hydrogen and oxygen. On the basis of these facts, the behavior of neutrons will obey a diffusion equation; and an age approximation can be used. (TTT)

40496 ON SOME PROBLEMS OF THE THEORY OF SLOW NEUTRON REACTIONS WITH SUBSTANCE. A. V. Stepanov. Tr. Fiz. Inst., Akad. Nauk SSSR, 24: 212-61 (1964). (In Russian)

The effects of chemical binding and thermal motion of atoms on the slowing down and diffusion of neutrons even at energies significantly above the thermal energies (~1 ev) are considered. The effect of the thermal motion of the moderator atoms can be taken into account by adopting a model of monoatomic gas. It is shown that when neutron absorption is small compared to neutron leakage from the moderator lattice, an age type of equation is obtained by means of a Laplace transform for the space-energy neutron distribution function which is independent of time. This function can be expressed in the form of a series according to energy groups. The asymptotic behavior of the energy and space-energy distribution of neutrons is investigated in a crystalline moderator (having an atomic weight ≫ 1) at a neutron energy $E \gg k_B T$ and $E \gg k_B \theta$. Here, k_B is the Boltzman constant, and θ is the Debye temperature. The solution is obtained in series form involving powers of the reciprocal neutron energy. The effect of the dynamic characteristics of the moderator on neutron thermalization is considered for the energy region $E \sim k_B T$. An attempt is made to describe analytically the thermalization of neutrons. The resonance interaction of slow neutrons with matter is considered. Chemical bonding and thermal motion have an affect on the shape of the neutron absorption line, and consequently, on the value of the effective resonance integral. An expression is obtained for the probability of absorption which can also be used in analyzing the resonance interaction of gamma-quanta with atomic nuclei. (TTT)

40497 NEUTRON GENERATION. Charles W. Tittle (to Laboratory for Electronics, Inc.). U. S. Patent 3,146,366. Aug. 25, 1964. Filed Oct. 5, 1959.

A neutron generator of the type in which D and/or T ions are accelerated onto D and/or T targets, is described which gives a high, constant neutron flux for a long period of time. In this generator, a D + T gas mixture is used with a D target; after some time of operation, the target is contaminated with T, and the T(d,n) reaction is added to the D(d,N) and D(t,n) reactions. The gas mixture should contain T and D in the proportion f and 1 – f, where $f = r/(1 + r)$, and r = ratio of D-T to T-D neutron yields for a certain ion energy. (D.L.C.)

Nuclear Properties and Reactions

Refer also to abstracts 39675, 40165, 40354, 40474, 40753, and 40805.

40498 (AAEC/E-119) THE A.A.E.C. NUCLEAR DATA CARD LIBRARY. G. Doherty (Australia. Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales). Mar. 1964. 16p.

The compilation of the A.A.E.C. nuclear data card library and the conventions relating to the use of the data in neutronics calculations are described. Details of data processing programs, library formats, and the extent of the information available for each nuclide are given. (auth)

40499 (AAEC/TM-252) THE RADIOACTIVITY OF THERMAL NEUTRON FISSION PRODUCTS OF U-235, U-233, AND Pu-239. C. R. Frost (Australia. Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales). June 1964. 27p.

The calculated individual and total β-radioactivity of thermal fission products of ^{235}U, ^{233}U, and ^{239}Pu are given for irradiation periods of 200, 300, 600, and 1000 days, and cooling periods from 0.1 to 100 years, neglecting neutron capture by fission products. All fission products with half lives greater than two days are considered. The calculated total fission product radioactivity data of ^{235}U and ^{239}Pu for 200 days and 1000 days irradiation and cooling periods to 100 years are compared with other published data. (auth) (auth)

40500 (AD-603251) NEUTRINO PRODUCTION OF LEPTON PAIRS (thesis). George Nicholas Stanciu (Michigan. Univ., Ann Arbor). 1964. Contract Nonr-1224(15). 95p.

The total cross section for the neutrino production of a lepton pair in the Coulomb field of a nucleus is calculated under the assumption that the universal four-fermion theory of weak interactions is correct at high energies. The total cross section for the neutrino production of a lepton pair in the electromagnetic field of a target particle (spin zero or spin one-half) is written as a sum of two four-fold Lorentz invariant integrals. The electromagnetic form factors are taken from elastic electron scattering experiments. The total cross section for muon pair production by a muon neutrino incident on a free proton and the total coherent cross sections for muon pair production by a muon neutrino incident on two different target nuclei, copper ($_{29}Cu^{63.5}$) and aluminum ($_{13}Al^{27}$), are numerically evaluated by use of an IBM 7090 computer. These cross sections are calculated for muon neutrino energies between 0.5 and 10 Bev. At 2.0 Bev the total cross section for production from a free proton is 1.05×10^{-44} cm^2 and the total coherent cross sections for production from $_{29}Cu^{63.5}$ and $_{13}Al^{27}$ are 5.53×10^{-43} and 1.83×10^{-43} cm^2, respectively. The total cross section for production from a complex nucleus is approximated by the total coherent cross section plus Z times the free proton total cross section where Z is the charge number of the nucleus. The total coherent cross sections for electron-positron pair production by a 0.2- and a 0.3-Bev electron neutrino incident on a bromine nucleus ($_{35}Br^{80}$) are also calculated; at 0.3 Bev the total coherent cross section is 1.45×10^{-42} cm^2. It is shown that the incoherent production at these energies is not important. (auth)

40501 (AE-152) ABSOLUTE E1 TRANSITION PROBABILITIES IN THE DEFORMED NUCLEI Yb^{177} AND Hf^{179}. Sven G. Malmskog (Aktiebolaget Atomenergi, Stockholm). Aug. 1964. 22p. (UDC-539-144-6)

The absolute E1-transition probabilities were measured for two $7/2-(514)$ levels populated from the short-lived isomers ^{177m}Yb (6.4 sec and ^{179m}Hf (18.6 sec), a delayed coincidence set up being used for the purpose. This gave a half life of $T_{1/2} = (4.48 \pm 0.08) \times 10^{-9}$ sec for the 104 kev level in ^{177}Yb and $T_{1/2} = (1.86 \pm 0.05) \times 10^{-9}$ sec for the 217 kev level in ^{179}Hf. The result was compared with the calculations made by Nilsson. The effect of the pairing correlation was also taken into account. An agreement with the experimental values to within a factor of three is obtained. An extrapolated estimate of the half life for the 408.9 kev $7/2-(514)$ level in ^{181}W gives 3×10^{-11} sec. (auth)

40502 (ANL-6886) CALCULATED VALUES OF WING-FONG'S NUCLIDIC MASS EQUATION. James Wing and Judith D. Varley (Argonne National Lab., Ill.). May 1964. Contract W-31-109-eng-38. 111p.

The semiempirical mass equation of Wing-Fong, which expresses the mass excess in terms of the mass number and proton number of a nuclide in terms of Mev and the mass-unit scale based on ^{12}C, was calculated using a CDC-3600 computer for nuclei of Z = 13 to 110. (R.E.U.)

40503 (CONF-417-31) DEUTERON CAPTURE IN C^{14}. John B. Nelson, Emmett L. Hudspeth, and E. M. Bernstein (Texas. Univ., Austin). [196?]. Contract AT(40-1)-3110. 28p.

From American Physical Society Meeting, Pasadena, Calif., Dec. 1963.

The $^{14}C(d,\gamma)^{16}N$ reaction was observed at 1.2 to 2.6 Mev. The cross section varies around a value of approximately 5 μb in that region, and there is strong evidence for resonances in the excitation curve. The resonant bombarding energies apparently correspond in at least two cases to those found in the competing (d,n) and (d,p) reactions. The results of cross section measurements for deuteron capture may be interpreted in term of compound nucleus formation. There is no evidence for direct capture; however, some contribution from this process cannot be excluded. The half-life of ^{15}C (re-determined in the course of analyzing our data) was measured as 2.49 ± 0.07 sec. (auth)

40504 (EUR-1643.e(p.196-203)) UPPER LIMIT TO PARITY NON-CONSERVATION IN STRONG INTERACTIONS, FROM A PRELIMINARY INVESTIGATION OF (n,d) CAPTURE. M. Forte (European Atomic Energy Community. Joint Nuclear Research Center, Ispra, Italy).

Experimental apparatus is described for studying the parity non-conservation effect in the forward-backward asymmetry in the angular distribution of gamma rays emitted from a compound nuclear state formed by capture of polarized neutrons. Preliminary results are given for a deuterium target. (R.E.U.)

40505 (IDO-16995) LOW-ENERGY NEUTRON FISSION CROSS SECTION OF Pu^{241}. T. Watanabe and O. D. Simpson (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). June 1964. Contract AT(10-1)-205. 55p.

The fission cross section of ^{241}Pu was measured from 0.02 to 100 ev using the Materials Testing Reactor (MTR) fast chopper. The fission events were detected by a gas scintillation fission chamber. Curves and tables of the fission cross section as a function of energy are given. The total and fission cross section data were used to obtain a fission cross section at thermal (0.0253 ev) of 962 ± 38 barns. (auth)

40506 (IS-878) FURTHER EVIDENCE FOR AN EXCEPTIONAL SUBSHELL CLOSURE AT 56 NEUTRONS IN $_{40}Zr^{96}$. F. Everling (Ames Lab., Ames, Iowa). [Apr. 1964]. Contract [W-7405-eng-82]. 6p. (CONF-502-19)

From International Congress of Nuclear Physics, Paris, July 1964.

The mass excess of $1g_{9/2}$ proton-shell nuclei from ^{92}Zr to ^{117}Sn is plotted for ground states and some levels in

sequences with constant neutron excess. Two trends for even nuclei are smooth, showing no 56-neutron-subshell effect in ^{100}Ru and ^{98}Mo. Another trend, however, shows ^{96}Zr to be low by more than 1 Mev. The probable $5/2^+$ trend including the ground state of ^{95}Zr resembles the step at ^{96}Zr, whereas apparently the $1/2^+$ trend, starting with the first ^{95}Zr level, resembles the smooth trend starting with ^{94}Zr. Probably ^{96}Zr undergoes a rearrangement when two or more protons are added. The results are in accordance with the work of B. L. Cohen, et al. The ^{103}Ru 0.135-Mev level is predicted to be $1/2^+$. (auth)

40507 (KAPL-3020) ABACUS-1: A PROGRAM FOR THE CALCULATION OF NUCLEAR CROSS SECTIONS USING THE CLOUDY CRYSTAL BALL MODEL. E. H. Auerbach, N. C. Francis, D. T. Goldman, and C. R. Lubitz (Knolls Atomic Power Lab., Schenectady, N. Y.). June 1, 1964. Contract W-31-109-eng-52. 54p.

ABACUS-1 is a digital computer program for Philco 2000 for the calculation of neutron-nucleus scattering and reaction cross sections. Both shape and compound elastic cross sections are calculated. Hauser-Feshbach theory is used for the calculation of the latter as well as for inelastic cross sections. Radial integrals are calculated for direct reaction calculations. A multidimensional search procedure is described for obtaining best optical model parameters. (auth)

40508 (LAMS-774) FISSION CROSS SECTION OF Th^{232} AND U^{235} FOR 14-Mev NEUTRONS. Anne Phillips, Louis Rosen, and R. F. Taschek (Los Alamos Scientific Lab., N. Mex.). Sept. 3, 1948. Contract [W-7405-eng-36]. 10p.

A microphotographic technique was employed to determine the fission cross section of ^{232}Th and ^{235}U relative to the fission cross section of ^{238}U for 14-Mev neutrons. Photographic plates in contact with foils of ^{238}U, ^{232}Th, and ^{235}U of known thicknesses were simultaneously exposed to the 14-Mev neutron flux. A determination of the number of tracks per unit area of plate per unit mass of foil permitted a determination of the relative cross sections. The Los Alamos Van de Graaff, utilizing the T(d,n)He^4 reaction, comprised the neutron source. The measurements yielded the following results: (σ_F"28"/σ_F"02") = 3.6 ± 0.3 and (σ_F"28"/σ_F"25") = 0.63 ± 0.07. (auth)

40509 (LAMS-938) FISSION CROSS SECTIONS OF THORIUM 232, URANIUM 233, 235, AND 236 AND PLUTONIUM 239 RELATIVE TO URANIUM 238 FOR 14-Mev NEUTRONS. Warren Nyer (Los Alamos Scientific Lab., N. Mex.). June 12, 1950. Contract [W-7405-eng-36]. 16p.

The fission cross sections were measured in a double chamber with thin foils using the 14-Mev neutrons from the D-T reaction. The results are tabulated. (auth)

40510 (MLM-907) THE HALF LIFE OF POLONIUM-208. Information Report. George L. Fox (Mound Lab., Miamisburg, Ohio). Oct. 28, 1953. Contract AT(33-1)-Gen-53. 4p.

The half life of ^{208}Po, determined by an alpha-counting technique, was found to be 2.89 ± 0.01 yr. This half life was determined on 2 samples counted over periods of 1.72 and 2.57 yr. Corrections were made for the 17 weight-per cent ^{209}Po and the 0.5 activity-per cent ^{210}Po present in the samples. The ^{208}Po was produced by 19-Mev proton bombardment of Bi in a cyclotron. (auth)

40511 (NP-14205) UPRUGOE RASSEYANIE POLYARIZOVANNYKH NEITRONOV YADRAMI Be^9, C^{12}, Co^{59}, Ni^{62}, Se^{80}, Nb^{93}, Cd^{114}, In^{115}, Sn^{118}, I^{127}, Pb N Bi^{209}. (Elastic Scattering of Polarized Neutron by Nuclei of Be^9, C^{12}, Co^{59}, Ni^{62}, Se^{80}, Nb^{93}, Cd^{114}, In^{115}, Sn^{118}, I^{127}, Pb and Bi^{209}). G. V. Gorlov, N. S. Lebedeva, and V. M. Morozov (U.S.S.R. Sovet Ministrov. Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoĭ Energii). 1964. 8p.

Differential cross sections of elastic neutron scattering were measured in a plane perpendicular to the polarization vector at scattering angles from 10 to 170°. Measurements were made every 10° with a resolving power of 4°. The observed nuclear polarization ability (50% and more) is a complex function of the scattering angle. (tr-auth)

40512 (NP-14239) ODNOCHASTICHNYE EFFEKTY V NEITRONNOI FIZIKE I TONKAYA STRUKTURA YADERNYKH MASS I ENERGETICHESKIKH SOSTOYANII (TEZISY). (Single Particle Effects in Neutron Physics and Fine Structure of Nuclear Masses and Energy States (Postulates)). S. I. Sukhoruchkii (Akademiya Nauk S.S.S.R. Institut Teoreticheskoi i Eksperimental'noi Fiziki, Moscow and U.S.S.R. Sovet Ministrov. Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii). 1964. 32p.

Parameters were found for the correlation between the effect of coincidences of neutron levels and neutron binding energies. Nucleon binding energies, mass excess of light nuclei, energies of low-lying excited states, and energies of strong electromagnetic transitions were also analyzed. One parameter was close to the value of the electron rest mass. (auth)

40513 (NP-14241) OB EFFEKTE NEMONOKHROMATICHNOSTI V IZMERENIYAKH METODOM PROPUSKANIYA SECHENIYA POGLOSHCHENIYA γ-KVANTOV LEGKIMI YADRAMI. (On the Influence of the Non-Monochromaticity on Measuring the Absorption Cross Section of γ Quanta by Light Nuclei Using the Transmission Method). G. V. Danilyan (Akademiya Nauk S.S.S.R. Institut Teoreticheskoi i Eksperimental'noi Fiziki, Moscow and U.S.S.R. Sovet Ministrov. Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii). 1964. 16p.

It is shown that the representation of the integral absorption cross section of γ-quanta by the light nuclei as an area under experimentally measured total cross section curves obtained by transmission method with relatively "bad" resolution is valid only for the case of "thin" absorbers. The analysis of the experimental data shows that the absorbers used in the experiments are far from "thin," due to that the integral cross sections calculated seem to be under-estimated by about 10 to 30%. To make more definite conclusions, the parameters of the levels responsible for giant resonance are required. The integral absorption cross sections of γ-quanta by the light nuclei obtained by the transmission method should be presently considered as a lower limit of the real value. (auth)

40514 (NYO-10693) LITERATURE SURVEY OF NUCLEON-2 NUCLEON REACTION CROSS SECTIONS AT ENERGIES ABOVE 100 Mev. Albert A. Caretto, Jr. (Carnegie Inst. of Tech., Pittsburgh). July 1964. Contract AT(30-1)-2897. 92p.

A literature survey was made of the experimental data available on (nucleon, 2 nucleon) reactions with complex target nuclei for incident energies above 100 Mev. When appropriate, all experimental cross sections listed were normalized to the ^{27}Al(p,3pn)^{24}Na and ^{12}C(p,pn)^{11}C monitor cross sections. Each entry listed in the tables was given a rating as to the reliability of the data in accordance with the criteria used in making these judgments. Data

are given for reactions (p,pn), (p,2p), (p,2n), (n,2n), and (n,np), and for selected reactions (p,n). A bibliography of 133 references is included. (R.E.U.)

40515 (ORNL-CPX-1) NUCLEAR CROSS SECTIONS FOR CHARGED-PARTICLE-INDUCED REACTIONS, Mn, Fe, Co. F. K. McGowan, W. T. Milner, and H. J. Kim, comps. (Oak Ridge National Lab., Tenn.). [1964]. Contract W-7405-eng-26. 445p.

A compilation of nuclear cross section data is given for charged-particle-induced reactions of ^{55}Mn, ^{54,56,57,58}Fe, and ^{59}Co, taken from literature before January 1, 1964. Both graphical and tabular data are included. (R.E.U.)

40516 (UCRL-11243) NEUTRONS FROM NEGATIVE MU-MESON CAPTURE (thesis). Burns Macdonald (California. Univ., Berkeley. Lawrence Radiation Lab.). June 29, 1964. Contract W-7405-eng-48. 78p.

Average neutron emission and neutron multiplicity distributions from μ^--meson capture in Al, Si, Ca, Fe, Ag, I, Au, and Pb were measured. A high-efficiency cadmium-loaded liquid scintillator tank was used having an efficiency of 54.5% for detecting neutrons from fission. Fermi gas and Gaussian nuclear models are used to fit the experimental results. A reduced nucleon effective mass is employed to give the observed average neutron multiplicity, and values are obtained as a function of the width of the nucleon momentum distribution assumed. Use of the Gaussian momentum distribution obtained in experiments on quasi-elastic scattering gives effective masses ranging from ≈ 0.7 M_p in the lighter nuclei to ≈ 0.45 M_p in the heavier nuclei. An excited Fermi gas distribution gives larger effective masses for the lighter nuclei and smaller effective masses for the heavier nuclei than does the Gaussian model. With either of these models the distributions of neutron multiplicities cannot be explained without allowing for direct neutron emission and clustering on the nuclear surface. For ^{40}Ca a shell-model calculation with a simple harmonic oscillator potential gave good agreement with the observed average neutron multiplicity. For both the Fermi gas and Gaussian models, the average nuclear excitation energy varies linearly with average neutron multiplicity and is relatively insensitive to the model parameters. When the average neutrino momentum is expressed in units of the muon mass reduced by its K-shell binding energy the result (with the exception of doubly magic calcium) is constant, 0.82 ± 0.01, over the wide range of atomic numbers covered in the experiment. (auth)

40517 (UCRL-11375) ANGULAR DISTRIBUTION OF NEUTRONS PRODUCED BY 40- AND 80-Mev α PARTICLES ON A THICK TANTALUM TARGET. William W. Wadman (California. Univ., Berkeley. Lawrence Radiation Lab.). May 1964. Contract W-7405-eng-48. 36p.

The angular distribution of neutrons was measured for 40- and 80-Mev α-particle beams on a thick elemental tantalum target. The measurement employed six different types of threshold reaction detectors with thresholds ranging from 1.2 to 12.4 Mev. The detectors were spaced about a ring 30 cm in diam. centered about the target. The target was contained within a Faraday cup in order to measure the total beam current. High voltage applied to a guard ring, which preceded the cup, was used to suppress secondary electron emission. Before irradiation of the detectors, the beam was shaped and centered while being watched by closed-circuit television during the alignment. The irradiated threshold detectors were analyzed with a 3-in. diam × 3-in. long NaI(Tl) crystal and a 400-channel pulse-height analyzer. The resulting data clearly indicate the existence of a prominent forward-directed neutron flux. The forward predominance is more pronounced in the higher-threshold energy detectors. The ratio of the 0 to 70° flux decreases with the energy at which a detector's reaction cross section is in its maximum region. This type of comparison is influenced by the shapes of the cross sections as a function of energy for each type of detector. The total fast-neutron yield was calculated approximately by using the ^{58}Ni(n,p)^{58}Co reaction and that neutron flux, which would be necessary to achieve the measured activity, and correcting for the anisotropy of the forward hemisphere. The neutron yield as a function of energy appears reasonable when compared with data of Allen, et al. Various limits are known and are related. The 80-Mev α-particle beam is known to be ±1 Mev. The 40-Mev α-particle beam is 41.2 ± 0.4 Mev. The counting statistics for the photopeaks vary from 0.29 to 3.93%, except those for the ^{200}Tl, which vary from 2.4 to 37.9%. Conversion from photopeak counts to neutron flux is considered to be ±15% with the exceptions of copper, iodine, and thallium (n,4n) data. All variations affect the entire set of threshold detector data and do not change the shape of the curve. The beam current was known to be ±3%, and detector angular location was ±1°. (auth)

40518 MEAN ENERGIES OF ELECTRON AND POSITRON β SPECTRA. N. S. Shimanskaya and E. G. Zaletskii. At. Energ. (USSR), 17: 9-17(July 1964). (In Russian)

Average energies $\overline{E}_\beta$ of electron and positron β-spectra were calculated for various values of radionuclide atomic number Z and initial β-spectrum energy E_0. Calculations were carried out for allowed transitions and for unique transitions of the first order of forbiddenness. Tables and graphs presented of values of $\overline{E}_\beta = f(E_0, Z)$ and $\overline{E}_\beta / E_0 = f(E_0, Z)$ can be used for estimating thermal effects of various radioactive preparations, of nuclear-reaction products, and of fission of elements by slow neutrons and high-energy nucleons, for calorimetric measurements of radioactive sources, and for calculating dosimetric characteristics of β-emitting preparations. A short survey is given of methods of determining average β-spectra energies and of experimental values obtained up to the present time for various radioisotopes. (tr-auth)

40519 ANALYSIS OF THE RESONANCE WIDTH DISTRIBUTIONS OF ^{233}U AND ^{239}Pu. L. N. Usachev, V. A. Pavlinchuk, and N. S. Rabotnov. At. Energ. (USSR), 17: 22-7(July 1964). (In Russian)

In results on strong fluctuations of fission and reduced neutron widths, a noticeable number of resonances appears with such a small reduced height $2g\Gamma_n^0/\Gamma$ that they will not be detected in experiment. If the portion of transmitted resonances is significant, then it ought to produce the following effects, which could be observed in experiment: (1) a change of the distribution function of reduced neutron and fission widths, which is developed especially sharply at $\Gamma_n^0/\langle\Gamma_n^0\rangle \ll 1$ and $\Gamma_f/\langle\Gamma_f\rangle \gg 1$; (2) the appearance of a correlation between the form of the distribution of neutron widths and the number of fission channels; (3) the appearance in the full cross section and the cross section of fission of a background approximately proportional to $1/\sqrt{E}$. All the demonstrated effects appear for the nucleus ^{233}U. For ^{239}Pu, this effect is small, and the observed magnitudes are well described by the χ^2 distributions. (tr-auth)

40520 CERTAIN DATA ON ^{244}Cm SPONTANEOUS FISSION. V. I. Bol'shov, L. I. Prokhorova, V. N. Okolovich, and G. N. Smirenkin. At. Energ. (USSR), 17: 28-34 (July 1964). (In Russian)

A determination is made of the average kinetic energy of fission fragments $\bar{E}_K = 182.3 \pm 2.3$ Mev, the width of the distribution for the half height $\Delta\bar{E}_K = 24.8 \pm 2.5$ Mev, and the average number of prompt neutrons for the spontaneous fission event $\bar{\nu} = 2.71 \pm 0.04$ in 244 Cm. In connection with the experimental results, the question of the dependence of $\bar{E}_K$ and $\bar{\nu}$ on the nucleon state of the fissioned nucleus is surveyed. Attention is turned to the correlation of anomalies in these variations with change of the most probable mass of fragments. An assumption of the connection of the observed effects with the change of elastic properties of the produced fragments is evaluated. (tr-auth)

40521 ELASTIC α-PARTICLE SCATTERING IN BORON. S. V. Starodubtsev and B. I. Khrushchev. At. Energ. (USSR), 17: 59-60(July 1964). (In Russian)

Results of measuring the scattering cross sections of α particles on natural and enriched (^{10}B, 86%) boron are presented. Beam energies were 13.6 and 14.7 Mev. Angular distributions are given. The interaction radius is calculated for both cases, using a formula for scattering in a right-angle potential in the Born approximation. The angular distributions agree with predictions of the optical model. Comparison of angular distributions for boron with those from other nuclei confirms the conclusion that the basic form of the transverse differential cross section is an alternation of maxima and minima; that with decreasing atomic number the oscillations increase and the position of greatest oscillation moves from large angles to small ones, the average slope of the angular distribution changes from negative to positive, and the distance between neighboring maxima increases. (M.J.T.)

40522 THE CONVERSION ELECTRON SPECTRUM EMITTED DURING THE TRANSMUTATION ^{234}Pa(6.7 hr) → ^{234}U. Chantal Briancon, Yvette Legoux, Jean Merinis, Roland Muxart, and Jacques Vernois (Faculte des Sciences, Orsay, France; Centre de Spectrometrie Nucleaire, Orsay, France; and CNRS, Orsay, France). Compt. Rend., 259: 345-8(July 15, 1964). (In French)

The conversion electron spectrum of the gamma rays emitted during the transmutation of ^{234}Pa(6.7 hr) into ^{234}U was studied with a 180° magnetic spectrometer. Some previously unreported conversion rays were observed, and values of the conversion ratios were obtained for some transitions. (tr-auth)

40523 THE MECHANISM OF A RADIOACTIVE DECAY WITH PROTON EMISSION. V. I. Gol'danskii (Inst. of Chemical Physics, Academy of Sciences, USSR). Dokl. Akad. Nauk SSSR, 157: 321-4(July 11, 1964). (In Russian)

The emission of delayed protons is due to the formation of an excited product of a positron decay. Two proton emitters were found. The "light" proton emitter has a half life $T_{1/2} = 0.085$ sec and a proton energy $E_p \approx 5 \pm 0.2$ Mev, the "heavy" proton emitter has $T_{1/2} = 23 \pm 4$ sec and $E_p = 2.5 \pm 0.2$ Mev. A comparison of $T_{1/2}$ and E_p indicates that in both cases the proton emission is delayed not by a Coulomb barrier, but by a previous positron decay. The isotopes ^{25}Si, ^{21}Mg, ^{21}Ne, and ^{13}O belong to the light group of proton emitters. The probability of positron decay with the emission of delayed protons is estimated as <0.05 for ^{25}Si and $<10^{-4}$ for ^{13}O. Thus, the ^{13}O cross-section for the formation of a delayed proton emitter is two orders smaller with ^{13}O than with ^{25}Si, ^{21}Mg, and ^{17}Ne. It is concluded that the "heavy" proton emitter is ^{70}Kr, which is formed by bombarding nickel with ^{20}Ne or ^{16}O in the following reactions: ^{58}Ni(^{20}Ne,α4n)^{70}Kr with a threshold of ~ 83 Mev and ^{58}Ni(^{16}O,4n)^{70}Kr with a threshold of ~73 Mev. The maximum positron decay energy of ^{70}Kr to the ^{70}Br ground state is 7.5 Mev, and the value of $T_{1/2} = 25$ sec corresponds to a log ft ≈ 6. Thus, the behavior of a "heavy" proton emitter is based on the emission of a delayed proton. This process is analogous to the emission of delayed alpha particles by light nuclei. (TTT)

40524 GENERATION OF HEAVY PARTICLES AND THEIR ROLE IN THE INTERPRETATION OF THE EXPERIMENT RESULTS OBTAINED WITHIN THE SUPER-HIGH ENERGY REGION. Zh. S. Takibaev, P. A. Usik, and L. A. San'ko (Inst. of Nuclear Physics, Academy of Sciences, Kazakh SSR). Dokl. Akad. Nauk SSSR, 157: 328-30(July 11, 1964). (In Russian)

When a nucleon collides with another nucleon or a nucleus at very high energies ($>10^{12}$ ev), two maxima are observed in the angular distribution of the particles from the collision. The fireball model was advanced in order to explain the formation of two centers of generation of pions. However, the fireball model could not explain all the facts, and it was proposed that an excited system is formed after the collision that breaks down into pions, mesons (K), resonons, and baryon pairs. The formation of energetically preferred particles is associated with a simple wave, the role of which is significant on taking into account the "viscosity" of the medium. The formation of heavy particles takes place primarily during breakdown of the simple wave. Energetically preferred pions can be formed directly during breakdown of the simple waves. Sometimes, two maxima in the angular distribution are obtained (the process is statistical in character). The angular and energy distribution of the particles is described by a hydrodynamical theory. (TTT)

40525 THE BINDING ENERGY OF HYPERTRITIUM IN THE CASE OF NON-LOCAL INTERACTION. I. Sh. Vashakidze and G. A. Chilashvili (Joint Inst. for Nuclear Research, Dubna, USSR). Dokl. Akad. Nauk SSSR, 157: 557-60(July 21, 1964). (In Russian)

The binding energy of hypertritium ($_\Lambda H^3$) is investigated on the assumption of a non-local, factorizing interaction between the particle pair and with the use of the Gell-Mann hypothesis of global symmetry. The principle of global symmetry assumes that ($\Sigma\Lambda\pi$) and ($\Sigma\Sigma\pi$) interactions are closely related with the ($NN\pi$) interaction so that the nucleon-nucleon potential can be related to the pion component of the hyperon-nucleon potential. In considering the Λ-N interaction, the $\Lambda N \rightleftharpoons \Sigma N$ potential should be taken into account because of the possibility of a Λ-N transition. The Schrödinger equations which taken into account the possibility of such transitions can be used to describe the full scattering problem. Although the three-body problem cannot be solved for local potentials, a system of unidimensional integral equations which can be readily solved by means of a computer is obtained in the case of a non-local, factorizing two-particle potential for the problem of three different particles. The total binding energy of $_\Lambda H^3$ is found by solving the set of related integral equations with the $\Lambda N \rightleftharpoons \Sigma N$ transition being taken into account. The numerical value for the binding energy of $_\Lambda H^3$ was calculated to be 2.904 Mev which is in satisfactory agreement with the experimental value of 2.3 Mev. (TTT)

40526 FISSION CROSS SECTIONS OF ^{231}Pa AND ^{233}Pu IN THE 1.5 TO 1500 kev ENERGY RANGE. S. M. Dubrovina and V. A. Shigin. Dokl. Akad. Nauk SSSR, 157: 561-2(July 21, 1964). (In Russian)

The number of fissionable isotopes such as ^{230}Th, ^{232}Th, and ^{234}U show significant irregularities in the fission cross

section as a function of neutron energy near the fission threshold. The odd-even isotopes ^{237}Np and ^{241}Am show a smoothly increasing fission cross section with increasing neutron energy without any noticeable irregularities. Hence, measurements were carried out on ^{231}Pa and ^{239}Pu to find out whether or not the absence of irregularities is characteristic of all odd-even isotopes. The results indicated that the fission cross section of ^{231}Pa is substantially different from the cross section variation found in ^{237}Np and ^{241}Am. The ^{231}Pa fission cross section shows three maxima at neutron energies of 330, 550, and 880 kev which are not listed in Hughes' compilation on Neutron Cross Sections. These measurements show that irregularities in the cross section variation are also observed in odd-even isotopes. (TTT)

40527 ANGULAR CORRELATIONS IN FORBIDDEN BETA TRANSITION. R. Yu. Volkovskii. Izv. Vysshikh Uchebn. Zavedenii, Fiz., No. 2, 71-2(1964). (In Russian)

Angular $\beta-\nu-\gamma$ correlation was calculated for non-oriented nuclei in first-forbidden β transition followed by internal bremsstrahlung. The asymmetry of recoil nucleus momenta in relation to the plane of electron and photon production is indicated. (tr-auth)

40528 NOTE ON THE HIGH ENERGY TRANSITION IN THE Ag^{110m} DECAY. W. H. Brantley, T. Katoh, and J. H. Hamilton (Vanderbilt Univ., Nashville). J. Phys. Soc. Japan, 19: 1257-8(July 1964).

The highest energy transition in the ^{110m}Ag decay was investigated and found to be 1383.68 ± 0.35. The energy of the level depopulated by this transition was determined to be 2925.88 ± 0.20. (C.E.S.)

40529 SLOW NEUTRON CAPTURE GAMMA RAYS FROM SAMARIUM AND GADOLINIUM. D. L. Sastry and S. Jnanananda (Andhra Univ., Waltair, India). J. Sci. Instr., 41: 497-500(Aug. 1964).

Slow neutron capture gamma rays in the energy region below 1.5 Mev from samarium oxide and gadolinium oxide have been studied, employing a simple technique comprising a 2-Curie polonium–beryllium neutron source and a single crystal scintillation spectrometer. The energies of the observed gamma components are estimated and compared with the values obtained using reactors as the sources of neutrons. (auth)

40530 ON A POSSIBILITY OF GENERALIZING WILKINS' EQUATION. K. Meyer (VEB Atomkraftwerk, Berlin). Kernenergie, 7: 381-5(June-July 1964). (In German)

One of the disadvantages of the Wilkins model is that it fails to take into consideration the effects predicated upon the chemical bond between the moderator nuclei. A synthetic scattering nucleus model was devised, which yielded a differential equation of the Wilkins type. This equation contained a parameter function the course of which was determined by the properties of a real scattering nucleus. A method for calculating the value of this parameter function was developed. Potential applications of this parameter function and of the new equation, actually a generalized Wilkins equation, are discussed. The asymptotic behavior of the solutions is considered. Possibilities for extending the function are indicated. (M.C.G.)

40531 DETERMINATION OF THE FAST NEUTRON SPECTRUM IN IRON BY MEANS OF THRESHOLD DETECTORS. K. Faehrmann (Zentralinstitut für Kernforschung, Rossendorf, Ger.). Kernenergie, 7: 401-6(June-July 1964).

By means of ^{103}Rh(n,n′)^{103m}Rh, ^{115}In(n,n′)^{115m}In, and the more conventional reactions ^{32}S(n,p)^{32}P, ^{27}Al(n,p)^{27}Mg, and ^{27}Al(n,α)^{24}Na fast neutron spectra in an iron pig (50 cm diameter by 45 cm), submitted to fission neutrons, were determined. The detectors employed were calibrated by fission neutrons from an uranium converter. The spectrum was assumed to be of the perturbed fission type with the perturbation function as a superposition of exponentials. The energy sensitivity of the reactions selected was compared with those of fission detectors, from which it was abstracted from the conventional characterization by "effective threshold energies." (auth)

40532 ON THE ENERGY DISTRIBUTION OF BACKSCATTERED ELECTRONS AS A FUNCTION OF DEFLECTION ANGLE. H.-W. Thuemmel (Institut für Angewandte Radioaktivität, Leipzig). Kernenergie, 7: 509-13(June-July 1964).

Electron backscattering energy and intensity distributions for perpendicular incidence were calculated as a function of deflection angle by introducing a supplementary angle dependence into Bothe's backscattering theory. Deviations from experimental results obtained by other authors were found to be especially high for high-Z scattering media. This was attributed to the fact that the effects of multiple scattering and iterated electron return were not taken into account. (auth)

40533 THE EFFECT OF NEUTRINOS POSSESSING A NON-ZERO MASS ON THE DECAY CONSTANT OF BOUND μ MESONS. Tibor Nagy (Lorant Eötvös Univ., Budapest). Magy. Fiz. Folyóirat, 12: 133-50(1964). (In Hungarian)

The unstable mesons(μ) decay into an electron and 2 neutrinos at an average life of 2.2×10^{-6} sec. The positive muons can be experimentally studied but the negative muons are involved in a number of complex processes: they are captured in the Coulomb field of the nucleus and reach the ground state within 10^{-9} sec. In view of the competition of these two processes, the time distribution of the decay electrons is determined not only by the decay constant but by the sum of the decay and capture probabilities. The capture probability is a function of the order number of the capturing material. An attempt was made to reconcile the previously noted differences between theoretical predictions and experimental results, making use of a new assumption of the theory of elementary particles, according to which there are 2 different neutrinos, one of which possesses a mass which at rest is different from 0. From the examination of the available experimental data it was concluded that the abnormally large value of the decay probability of bound mesons(μ) in the vicinity of Fe cannot be explained on the basis of the currently accepted theories. It appears highly desirable to repeat the experiments before reevaluating the assumptions of the theory. Recent measurements seem to indicate that the decay probability does not have a maximum at Z = 26. (TTT)

40534 PHOTODISINTEGRATION OF Be^9 ABOVE 18 Mev. C. Becchi, L. Meneghetti, M. Sanzone, and S. Vitale (Università, Genoa and Euratom-CNEN). Nucl. Phys., 59: 375-84(Oct. 1964).

An experimental analysis of ^{9}Be photodisintegration processes, involving the emission of α particles of energy greater than about 4 Mev, shows that in the energy range of 18 to 25 Mev the (γ,n) reaction mainly leads to the 16.6-Mev level of the residual ^{8*}Be nucleus that decays into two α particles. Resonances of ^{9*}Be are identified at 18.7 ± 0.4, 20 ± 0.5, 20.9 ± 0.6, and 25 ± 2 Mev; there are some indications of a resonance at about 29 ± 3 Mev. The resonances in the ^{9}Be(γ,n) and ^{9}Be(γ,p) cross section at about 22 Mev are attributed to photon absorption by the $p_{\frac{1}{2}}$ core nucleons. (auth)

40535 THE SCATTERING OF HIGH-ENERGY ELECTRONS BY S^{32}. R. Lombard, P. Kossanyi-Demay, and G. R. Bishop (Ecole Normale Superieure, Orsay, France). Nucl. Phys., 59: 398-416(Oct. 1964).

The cross section for elastic and inelastic scattering of electrons by the nucleus ^{32}S was measured. The elastic cross section is fitted well by a phase shift calculation for a static charge density with parameters C = 3.20 fm and t = 2.6 fm. The inelastic cross sections are analyzed by the expressions derived in first Born approximation and the analysis leads to spin and parity assignments to a number of the levels of ^{32}S with measurements of the corresponding reduced transition probabilities. (auth)

40536 FRAGMENTATION THEORY IN THE QUASI-ELASTIC SCATTERING OF FAST PARTICLES ON LIGHT NUCLEI. V. V. Balashov, A. N. Boyarkina, and I. Rotter (Joint Inst. for Nuclear Research, Dubna, USSR). Nucl. Phys., 59: 417-43(Oct. 1964).

The quasi-elastic knock-out of single nucleons, deuterons, α particles, and other fragments from light nuclei is considered in impulse approximation. The momentum distribution of clusters in the nucleus, the excitation spectrum of the residual nucleus when a fragment is ejected, and the ratio of the contributions of different fragmentation channels are calculated by the shell model taking into account nucleon-nucleon pair correlations. The important role of the fractional parentage principle is shown, and a critical appraisal is given of the single-particle approach to the problem. The results of the calculations are in agreement with experiment. Further experimental problems are discussed. (auth)

40537 NUCLEAR MATTER BINDING ENERGY AND THE TWO-NUCLEON POTENTIAL. Nester Azziz and Peter Signell (Pennsylvania State Univ., University Park). Nucl. Phys., 59: 444-8(Oct. 1964).

The Moszkowski-Scott approximation to the Brueckner theory is used to compare the nuclear matter binding energy predictions of two different two-nucleon potential models. Although the Hamada-Johnston potential was found to be a much better fit to the two-nucleon data than is the Brueckner-Gammel-Thaler potential, the latter is found to be in much better agreement with the semi-empirical value of the nuclear matter binding energy. The discrepancy is found to be attributable mostly to the singlet odd potential, which was only poorly defined by the available two nucleon data. (auth)

40538 SCATTERING OF HIGH-ENERGY DEUTERONS FROM CARBON. M. L. Rustgi (Univ. of Southern California, Los Angeles). Nucl. Phys., 59: 460-74(Oct. 1964).

The scattering of high-energy deuterons from a spin zero target is treated within the frame-work of the Glauber approximation. The optical potential that describes the scattering process is constructed in terms of the nucleon-nucleus scattering amplitude. The numerical results for the angular distribution, the vector and tensor polarizations for the scattering of 420-Mev deuterons from carbon are compared with the experimental data of Button and Mermod. (auth)

40539 NUCLEAR POLARIZATION OF Ir^{192} IN IRON. J. A. Cameron, I. A. Campbell, J. P. Compton, R. A. G. Lines, and N. J. Stone (Oxford Univ.). Nucl. Phys., 59: 475-80(Oct. 1964).

The anisotropy of γ rays from ^{192}Ir polarized in iron was measured at temperatures between 0.1 and 0.012°K. The hyperfine coupling energy was found to be $|\mu_{192}H_{eff}| = 1.35 \pm 0.03 \times 10^{-17}$ erg. From this value a magnetic moment of 1.9 ± 0.4 nm is derived. The 4^- to $4^+\beta$ decay to the 785-kev level of ^{192}Pt carries away an angular momentum $j_\beta = 1$. The spin of the 1201-kev level of ^{192}Pt is 4. (auth)

40540 SECOND-FORBIDDEN DECAYS OF Cl^{36}. P. Lipnik, G. Pralong, and J. W. Sunier (Federal Inst. of Tech., Zurich). Nucl. Phys., 59: 504-12(Oct. 1964).

The internal bremsstrahlung spectrum (IBS) associated with the second-forbidden electron capture decay of ^{36}Cl was measured between 0.66 Mev and the end-point energy E_0 of the transition. The shape factor of the IBS spectrum is nearly constant within this energy range. The transition energy is measured to be $E_0 = 1178 \pm 51$ kev. The experimental shape factors of the ^{36}Cl-(IBS)-^{36}S and ^{36}Cl-(β^-)-^{36}Ar spectra are compared with theoretical predictions. The ground state configurations of ^{36}Cl, ^{36}Ar, and ^{36}S are assumed to be $((d_{\frac{3}{2}})_p, (d_{\frac{3}{2}})_n; J^\pi)$ in the j-j coupling scheme of the shell model. The relations between the vector matrix elements of the beta interaction, as predicted by the conserved vector current theory, is taken into account. (auth)

40541 QUADRUPOLE MATRIX ELEMENTS IN O^{17} AND F^{17}. F. C. Barker (Australian National Univ., Canberra). Nucl. Phys., 59: 513-24(Oct. 1964).

The model of the low-lying states of ^{17}O and ^{17}F in which a distortion of the ^{16}O core is produced by a two-particle central interaction between the odd nucleon and the core nucleons is investigated in first order perturbation theory. It is found that T = 1 excitations of the core give appreciable contributions to E2 matrix elements. The experimental values of the ^{17}O quadrupole moment and the lifetime of the first excited state of ^{17}O cannot be fitted consistently, and this may be due to inadequacy of first-order perturbation theory or to the assumption that single 2^+ (T = 0 and T = 1) states of ^{16}O contribute to the distortion. Otherwise the values of parameters required for fitting the ^{17}O data separately are not unreasonable. In order to fit the measured lifetime of the first excited state of ^{17}F the required value of the matrix element $\langle 2s|r^2|1d\rangle$ is less negative than that calculated for realistic single particle wave functions. Inclusion of recoil effects partly removes this discrepancy. (auth)

40542 GAMMA RAY YIELDS FROM 2.00 TO 4.10 Mev PROTON BOMBARDMENT OF B^{10}. E. M. Bernstein (Univ. of Texas, Austin). Nucl. Phys., 59: 525-8(Oct. 1964).

The yield of gamma rays from the $^{10}B(p,\alpha\gamma)^7Be$ and $^{10}B(p,p'\gamma)^{10}B$ reactions were measured for proton energies between 2.00 and 4.10 Mev. In addition to a previously reported resonance in the $(p,\alpha\gamma)$ reaction at a bombarding energy of 3.030 ± 0.01 Mev, resonances in this reaction were also observed at 2.189 ± 0.005, 2.320 ± 0.005, 2.574 ± 0.005, and 3.592 ± 0.007 Mev. (auth)

40543 TOTAL NEUTRON CROSS SECTION OF Pa^{233} FROM 0.01 TO 1.0 ev. F. B. Simpson, J. W. Codding, and J. R. Berreth (Phillips Petroleum Co., Idaho Falls, Idaho). Nucl. Sci. Eng., 20: 235-6(Oct. 1964).

The experimental procedures for determining the total neutron cross section of ^{233}Pa from 0.01 to 1.0 ev are outlined, and the cross sections data are tabulated. (C.E.S.)

40544 INELASTIC NEUTRON SCATTERING BY SOME HYDROGENOUS MODERATORS. W. Glaeser and K. H. Beckurts (Kernforschungszentrum, Karlsruhe, Ger.). Nucl. Sci. Eng., 20: 236-8(Oct. 1964).

By means of a rotating crystal time-of-flight spectrometer technique neutron scattering laws for benzene, diphenyl, and Dowtherm A were measured. The results were compared with numerical calculations. (C.E.S.)

40545 THE FLAT SOURCE APPROXIMATION IN RESONANCE INTEGRAL CALCULATIONS. Jon Berg (Institutt for Atomenergi, Kjeller, Norway). Nukleonik, 6: 202-9(July 1964).

A method is presented for analyzing the error in resonance integral calculations due to the assumption that the scattering source is spatially flat inside the lump. The error in the resonance integrals for individual resonances is calculated under different conditions. The relative error in the resonance integral of ^{238}U is estimated. (D.C.W.)

40546 PRELIMINARY RESULTS CONCERNING THE EMISSION OF FAST FRAGMENTS FROM THE INTERACTIONS OF 25-Gev PROTONS WITH HEAVY NUCLEI OF PHOTOGRAPHIC EMULSION. M. Sieminska, M. Soltan, K. Soltynaki, and J. Suchorzewska. Nukleonika, 9: 87-9 (1964). (In Russian)

The production of fast multicharged particles, with $Z > 2$ and energy >8 Mev/nucleon, from reactions of 25-Bev protons with the nuclei of Ilford KO emulsions was studied. Angular distributions of fast fragments are given. Distributions of the angles between fragments and nuclei are compared with the distributions of ^{8}Li fragments of all energies. (M.J.T.)

40547 EMISSION OF ^{8}Li FRAGMENTS FROM THE INTERACTIONS OF FAST PARTICLES WITH HEAVY NUCLEI OF PHOTOGRAPHIC EMULSION. W. Gajewski. Nukleonika, 9: 91-4(1964). (In Russian)

Data from previous experiments on the reactions of 9- and 24-Bev protons and 1.3- and 1.5-Bev/c K^- mesons with Ag and Br emulsion nuclei are studied. Probabilities of ^{8}Li-fragment emission are given. Anisotropy of angular distributions of ^{8}Li fragments is explained in terms of average emission velocity. Experimental energy spectra of the fragments are compared with spectra calculated on the basis of the evaporation model. (M.J.T.)

40548 PRODUCTION OF LIGHT MESONIC HYPERFRAGMENTS AND Li^{8} FRAGMENTS FROM THE INTERACTION OF 1.3 Gev/c AND 1.5 Gev/c K^- MESONS WITH EMULSION NUCLEI. J. Zakrzewski (Univ. of Warsaw). Nukleonika, 9: 95(1964).

The production of light mesonic hyperfragments and ^{8}Li fragments from the interactions of 1.3 Bev/c and 1.5 Bev/c K^- mesons with nuclei of a photographic emulsion was studied. The charge distribution of light mesonic hyperfragments, their range and angular distributions as a function of the prong number of the primary star, the frequency of emission of ^{8}Li fragments as a function of the incident K^--meson momentum and of the prong number of the primary star, the momentum transfer from the incident K^--mesons to the struck nuclei, and the energy distribution of the emitted ^{8}Li fragments were investigated. (auth)

40549 INVESTIGATION OF $\pi^- + Xe \rightarrow \pi^- + \pi^0 + Xe$ INTERACTIONS AT 9 Gev/c PRIMARY MOMENTUM. I. M. Gramenitskii, I. A. Ivanovskaya, T. Kanarek, L. S. Ohrimenko, A. Prokesh, and L. A. Tihonova. Nukleonika, 9: 141-6(1964). (In Russian)

A study was made of the production of π^- and π^0 mesons in π^- meson interactions with Xe nuclei for small momentum transfer to the recoil nucleus, to investigate the process of Coulomb generation of π^0 mesons. A xenon bubble chamber was irradiated by a 9 Bev/c π^- meson beam. Of 54,000 compressions, 290 were found having two conversion photons. The angles of flight of the photons and π^- mesons were measured. The energy spectrum of the gamma quanta is presented. The effective mass of the two gamma quanta was calculated, and the effective mass spectrum is given and compared with results from Monte-Carlo calculations. Negative pion angular distributions are given for events with two and three gamma quanta. The dependence of the angles of flight of secondary π^- mesons on momentum transferred to the Xe nucleus is presented. (M.J.T.)

40550 INVESTIGATION OF THE PRODUCTION OF PHOTONS AND NEUTRAL MESONS IN π^- COLLISIONS IN Xe BUBBLE CHAMBER AT 9 Gev. O. Czyzewski (Inst. of Nuclear Research, Krakow), J. A. Danysz, J. Loskiewicz, J. Zaorska, B. Slowinski, and Z. Strugalski. Nukleonika, 9: 155-60(1964).

About 2500 photographs were scanned for interactions producing photons and neutral mesons and the electron-positron pairs associated with them. 277 stars were measured. The angular distribution and energy spectrum of the photons are given; peaks near 270 Mev correspond to the two γ decay mode of the η^0 meson. The invariant-mass distribution for two-photon combinations from 46 two-γ stars is presented; the results for 29 three-photon stars are similar. The energy spectrum of photons from stars with photon multiplicity greater than four is graphed. Results are in agreement with previous experiment. (M.J.T.)

40551 SOME RESULTS ON INTERACTIONS OF HIGH-ENERGY PARTICLES WITH HEAVY NUCLEI. E. Cieslak (Univ. of Warsaw), K. Garbowska-Pniewska, E. Skrzypczak, P. Ciok, T. Saniewska, and P. Zielinski. Nukleonika, 9: 217-27(1964).

Interactions of 151 24-Bev/c protons and 133 17-Bev/c pions with Ag and Br emulsion nuclei were studied, using strong magnetic field—180 and 170 kG respectively—during exposures. Signs of charge, momenta, emission angles, and types of parent stars were determined for 310 flat fast and 86 slower secondaries from p reactions and for 318 fast secondaries from π reactions. Angular distributions, momentum spectra, and transverse momentum distributions are presented for fast secondaries from both reaction types and for excess of fast positive particles from p-nucleus reactions. Inelasticity coefficients for fast pion and proton emission were computed. Transverse momentum values are correlated with total momentum and emission angle values. (M.J.T.)

40552 BREMSSTRAHLUNG SPECTRUM OF 600 Mev POSITRONS AND ELECTRONS IN PROPANE. E. Malamud and R. Weill (E.P.U.L., Lausanne, Switzerland). Nuovo Cimento (10), 33: 1287-99(Sept. 1, 1964).

The high-energy end of the bremsstrahlung spectrum of 600-Mev electrons and positrons was studied in a propane bubble chamber. The cross section for the emission of a photon having more than 88% of the initial electron energy is found to be larger than the theoretical calculations. The difference is $(4.6 \pm 3.7)\%$ for positrons and $(17.3 \pm 4.8)\%$ for electrons. The ratio of positron to electron bremsstrahlung is 0.89 ± 0.04. If only events where the photon has > 98% of the initial energy are considered, then the measured ratio of cross sections is 0.82 ± 0.12. (auth)

40553 TIME-REVERSAL INVARIANCE IN STRONG INTERACTIONS. II. — β-γ_1-γ_2 ANGULAR CORRELATION IN ^{106}Rh. E. Fuschini, V. Gadjokov, C. Maroni, and P. Veronesi (Università, Bologna). Nuovo Cimento (10), 33: 1309-11(Sept. 1, 1964).

β-γ_1-γ_2 angular correlation in ^{106}Rh is used as a test of time-reversal invariance in strong interactions. The upper limit obtained for F (F is the relative amplitude of the irregular part of the hamiltonian with respect to the regular one) is about 4%. (auth)

40554 CHARGE SYMMETRY OF THE AXIAL CURRENT AND RADIATIVE MUON ABSORPTION BY A NUCLEUS. E. Borchi and R. Gatto (Università, Florence and CNEN, Rome). Nuovo Cimento (10), 33: 1472-80(Sept. 1, 1964).

The contribution from a possible second-class axial current to radiative meson (μ) absorption by nuclei is examined. This process is very sensitive to the presence of a second-class axial term. The theoretical results are compared with results of radiative meson (μ^-) absorption in ^{40}Ca. (C.E.S.)

40555 ROTATIONALLY INVARIANT MEASURES IN THE DUAL SPACE OF A NUCLEAR SPACE. Yasou Umemura. Proc. Japan Acad., 38: 15-17(Jan. 1962).

It is shown that any rotationally invariant measure in a Hilbert space is expressed as a superposition of Gaussian measures. (D.C.W.)

40556 MONOPOLE PART OF MAJORANA FORCES AND GIANT DIPOLE RESONANCE IN THE 1d-2s SHELL NUCLEI. V. G. Neudatchin (Universitet, Copenhagen) and V. G. Shevchenko. Phys. Letters, 12: 18-20(Sept. 1, 1964).

Dipole absorption is explained in terms of the Nilsson model including the monopole part of the Majorana forces. The nuclei ^{24}Mg and ^{32}S are specifically considered. (D.C.W.)

40557 l-RETARDED β-TRANSITIONS OF GAMOW-TELLER TYPE IN Ni^{63}, Ni^{65}, AND P^{32} NUCLEI. B. L. Birbrair (Inst. of Physics and Tech., Leningrad). Phys. Letters, 12: 20-1(Sept. 1, 1964).

The degree of l-retardation of beta transitions of the Gamow-Teller type in ^{63}Ni, ^{65}Ni, and ^{32}P was estimated using a phenomenological method based on the Landau Fermi-liquid theory. (D.C.W.)

40558 IMPURITIES IN ISOBARIC ANALOGUE STATES. C. Bloch and J. P. Schiffer (Princeton Univ., N. J.). Phys. Letters, 12: 22-4(Sept. 1, 1964).

The widths of isobaric-spin analog states were investigated, with particular attention to the effects of mixing of analog states into normal states. (D.C.W.)

40559 ON THE EXISTENCE OF AN INTERNUCLEON POTENTIAL NOT CONSERVING SPACIAL PARITY. Yu. G. Abov, P. A. Krupchitskii, and Yu. A. Oratovskii (Inst. for Theoretical and Experimental Phys., Moscow). Phys. Letters, 12: 25-6(Sept. 1, 1964).

The existence of an internucleon potential that does not conserve spatial parity was investigated by measuring the asymmetry of the gamma angular distribution from capture of polarized neutrons. From the asymmetry coefficient and theoretical calculations, the ratio of the potential not conserving parity to the potential conserving parity was found to be of the order of 10^{-7}. (D.C.W.)

40560 THE ISOMERIC STATE OF Sc^{45}. J. L. Yntema and J. R. Erskine (Argonne National Lab., Ill.). Phys. Letters, 12: 26-8(Sept. 1, 1964).

The alpha particle spectra from the ^{48}Ti(p,α)^{45}Sc reaction at about 12 Mev were measured at scattering angles of 30, 45, and 60° using a broad-range magnetic spectrograph. The results established the existence of a 13-kev, $^3/_2^+$ (first-excited) state in ^{45}Sc. The ground-state Q value for the reaction was determined to be -2.560 ± 0.005 kev. (D.C.W.)

40561 DYNAMIC CONVERSION-ELECTRON SPECTROSCOPY AND NEW DOUBLETS OF THE TWO PHONON STATES IN NEUTRON-DEFICIENT EVEN NUCLEI IN THE VIBRATIONAL REGION. M. Sakai, T. Yamazaki, and H. Ejiri (Tokyo Univ.). Phys. Letters, 12: 29-32(Sept. 1, 1964).

The spectra of conversion electrons from (p,2n) reactions at 12 to 14 Mev with ^{197}Au, ^{133}Cs, ^{121}Sb, ^{123}Sb, ^{107}Ag, ^{109}Ag, ^{103}Rh, ^{191}Tr, ^{193}Tr, and ^{127}I were measured. The variation of line intensity with energy was examined, and an interpretation of the lines was derived. Doublets of the two-phonon triplet were assigned in ^{102}Pd, ^{108}Cd, ^{120}Te, ^{122}Te, ^{126}Xe, ^{132}Ba, ^{190}Pt, ^{192}Pt, and ^{196}Hg. (D.C.W.)

40562 HALF-LIFE MEASUREMENTS OF EXCITED STATES IN Ta^{179} AND Tm^{167}. K. E. G. Loebner (Instituut voor Kernphysisch Onderzoek, Amsterdam). Phys. Letters, 12: 33-5(Sept. 1, 1964).

The half life of the 30.7-kev level of ^{179}Ta was determined to be 1.42 ± 0.08 μsec by measuring delays between the electron capture K x rays and the 30.7-kev gamma rays from the decay of ^{179}W. The transition probability for the E1, $\Delta K = 1$ transition from the $^9/_2$ $^9/_2^-$ (514) state to the $^7/_2$ $^7/_2^+$ (404) state was also studied. The half life of the 179.4-kev level of ^{167}Tm was determined to be 1.16 ± 0.06 μsec by measuring delays between the electron capture K x rays in the decay of ^{167}Yb. The transition probabilities for two $\Delta K = 3$, M1 transitions in ^{167}Tm from the $^7/_2$ $^7/_2^+$ (404) state to the $^5/_2$ and $^7/_2$ members of the $^1/_2^+$ (411) rotational band were also determined. (D.C.W.)

40563 MÖSSBAUER SCATTERING OF THE 155 kev TRANSITION OF Os^{188}. R. J. Morrison, M. Atac, P. Debrunner, and H. Frauenfelder (Univ. of Illinois, Urbana). Phys. Letters, 12: 35-7(Sept. 1, 1964).

The Mössbauer effect of the 155-kev gamma rays of ^{188}Os was observed in a scattering geometry. With a source of ^{188}Re in Re metal and a natural Os scatterer, a slightly broadened line was detected. The Mössbauer scattering of the 137-kev gamma rays of ^{186}Os was also measured using the same geometry and scatterer. The recoilless fractions and Debye temperatures were determined. (D.C.W.)

40564 MÖSSBAUER EFFECT IN Ta^{181}. S. G. Cohen (Hebrew Univ., Jerusalem), A. Marinov, and J. I. Budnick. Phys. Letters, 12: 38-40(Sept. 1, 1964).

The detection of recoilless absorption in ^{181}Ta was investigated. Experiments on absorption of the 6.25-kev gamma rays were performed using TaC and $KTaO_3$ absorbers and sources of ^{181}W in W metal and Ba_2CaWO_6. The absorption was also studied analytically. (D.C.W.)

40565 CALCULUS OF THE ABSOLUTE LOG (ft) VALUES FOR THE β-TRANSITIONS OF THE $^1/_2^+ \rightleftharpoons ^1/_2^-$ TYPE OF THE ODD-A NUCLEI ($150 < A < 190$). D. Bogdan and T. Badica (Joint Inst. for Nuclear Research, Dubna, USSR). Phys. Letters, 12: 40-1(Sept. 1, 1964).

The absolute reduced half lives were calculated using the Kotani formula corrected with the Soloviev superfluid expression. The theoretical values were systematically smaller than the experimental values corrected by the Kotani term. (D.C.W.)

40566 THE B^{10}(He^3,pα)2He^4 REACTION. J. E. Etter, M. A. Waggoner, H. D. Holmgren, C. Moazed, and A. A. Jaffe (Univ. of Maryland, College Park). Phys. Letters, 12: 42-5(Sept. 1, 1964). (TID-20905)

The reaction ^{10}B(He-3,pα)2^{4}He was investigated, specifically the process by which the four-body final state (one proton–3 alpha particles) is formed. The energy and direction of the proton and one alpha particle were measured using two solid-state detectors. (D.C.W.)

40567 THE Be^9(He^3,α)2He^4 REACTION. C. Moazed, J. E. Etter, H. D. Holmgren, and M. A. Waggoner (Univ. of Maryland, College Park). Phys. Letters, 12: 45-8 (Sept. 1, 1964). (TID-20908)

The two-dimensional energy spectra and projections for the $^{9}Be(He\text{-}3,\alpha)2^{4}He$ reaction indicate that at ^{3}He energies around 3 Mev virtually no quasi-instantaneous breakup processes are involved in which the total energy is statistically distributed among the three alpha particles. Two possible interpretations of the reaction are given. (D.C.W.)

40568 IMPORTANCE OF A STUDY OF THE DECAY OF Ca^{37} TO THE PROBLEM OF DETECTING SOLAR NEUTRINOS. J. N. Bahcall and C. A. Barnes (California Inst. of Tech., Pasadena). Phys. Letters, 12: 48-9 (Sept. 1, 1964).

It is pointed out that a study of the beta decay of ^{37}Ca would provide the information necessary for detection and measurement of solar neutrinos by the reaction $^{37}Cl + \nu \rightarrow {}^{37}Ar + e$. (D.C.W.)

40569 $Si^{28}(\gamma,p)Al^{27}$ AND $Si^{28}(\gamma,\alpha)Mg^{24}$ REACTIONS BY MONOCHROMATIC GAMMA-RAYS OF 17.5–22.3 Mev. S. Matsumoto, H. Yamashita, T. Kamae, and Y. Nogami (Tokyo Univ.). Phys. Letters, 12: 49-51(Sept. 1, 1964).

The total cross sections for (γ,α) and (γ,p) reactions to various levels at 17.5 to 22.3 Mev were measured, using photons from proton capture in ^{7}Li and T at proton energy steps of 100 to 300 kev. Resonance effects were observed in proton emission with the relative intensities varying strongly with gamma energy. The resonance width was of the order of 100 kev. Several bumps were observed in the (γ,α) cross section, possibly due to E1 absorption. (D.C.W.)

40570 $He^{3}(d,t)2p$ AND $He^{3}(He^{3},\alpha)2p$ REACTIONS. K. P. Artjomov, V. J. Chuev, V. Z. Goldberg, A. A. Ogloblin, V. P. Rudakov, and J. N. Serikov (Kurchatov Atomic Energy Inst., Moscow). Phys. Letters, 12: 53-5(Sept. 1, 1964).

The alpha particle and triton spectra of the $^{3}He(^{3}He,\alpha)2p$ and $^{3}He(d,t)2p$ reactions, respectively, were measured at several angles between 5 and 20°. The data resemble those for the D(p,n)2p reaction in which the shape of the neutron spectra was explained in terms of final-state interactions of the two protons. (D.C.W.)

40571 SHELL-MODEL SELECTION RULES AND EXCITATION OF 4^{+} STATES IN THE $Ti(\alpha,\alpha')$ REACTION. G. R. Satchler (Oak Ridge National Lab., Tenn.), J. L. Yntema, and H. W. Broek. Phys. Letters, 12: 55-6(Sept. 1, 1964).

The scattering of 43-Mev alpha particles by ^{46}Ti, ^{48}Ti, and ^{50}Ti was measured. The data on excitation of 4^{+} states were fitted by weighting the direct and multiple amplitudes in the vibrational model predictions. Evidence in favor of the shell model predictions for the excitation amplitudes was observed, particularly the signature selection rule for ^{48}Ti. (D.C.W.)

40572 MEASUREMENTS OF NEGATIVE-MUON LIFETIMES IN LIGHT ISOTOPES. M. Eckhause, T. A. Filippas, R. B. Sutton, and R. E. Walsh (Carnegie Inst. of Tech., Pittsburgh). Phys. Rev., 132: 422-5(Oct. 1, 1964).

Negative muons were stopped in the following targets: separated isotopes of lithium (^{6}Li and ^{7}Li) and boron (^{10}B and ^{11}B), and natural beryllium, carbon, nitrogen, and oxygen. From an analysis of the resulting time spectrum of the decay electrons, the negative-muon lifetime in each of these substances was obtained. From a separate measurement of the μ^{+} lifetime, (2.202 ± 0.003) μsec, the capture rates in the above elements were determined. They are (in units of 10^{5}/sec); $\lambda_{cap}(^{6}Li) = 0.061 \pm 0.014$, $\lambda_{cap}(^{7}Li) = 0.018 \pm 0.014$, $\lambda_{cap}(^{10}B) = 0.265 \pm 0.015$, $\lambda_{cap}(^{11}B) = 0.218 \pm 0.016$, $\lambda_{cap}(Be) = 0.10 \pm 0.02$, $\lambda_{cap}(C) = 0.397 \pm 0.013$, $\lambda_{cap}(N) = 0.65 \pm 0.04$, and $\lambda_{cap}(O) = 0.98 \pm 0.03$. (auth)

40573 L-SHELL FLUORESCENCE YIELDS IN ELEMENTS BETWEEN Z = 40 AND 51. R. C. Jopson, Hans Mark, C. D. Swift, and M. A. Williamson (Univ. of California, Livermore). Phys. Rev., 136: A69-73(Oct. 5, 1964). (UCRL-7694)

The partial L-shell fluorescence yields of eight elements between Z = 40 and 51 have been determined using a coincidence counting method. Vacancies are created in the K shell by the photoelectric absorption of suitable radiations. The coincidence rate between the K and L x rays emitted subsequent to the ionizing event determines the partial L-shell fluorescence yield ω_{KL}. The L x rays were observed with a proportional counter and the K x rays with a scintillation counter. The following values were obtained for ω_{KL}: zirconium, 0.034 ± 0.010; niobium, 0.036 ± 0.010; palladium, 0.047 ± 0.010; silver, 0.054 ± 0.007; cadmium, 0.055 ± 0.012; indium, 0.065 ± 0.012; tin, 0.064 ± 0.012; and antimony, 0.070 ± 0.013. (auth)

40574 SCATTERING OF SLOW NEUTRONS FROM METHANE GAS. R. M. Brugger (Phillips Petroleum Co. Idaho Falls, Idaho), V. S. Rainey, and H. L. McMurry, Phys. Rev., 136: A106-8(Oct. 5, 1964).

The intensities of neutrons scattered with discrete energy changes from a sample of room-temperature methane gas were measured to high enough energy changes to show the effects of excitation of the lowest vibrational states. A calculation which includes the effects of excitation of these lowest vibrational states agrees qualitatively but not quantitatively with the data. (auth)

40575 CHARACTERISTIC X-RAY PRODUCTION IN THE M_{V} SHELL IN YTTERBIUM BY 30–100-kev PROTONS. J. M. Khan, D. L. Potter, and R. D. Worley (Univ. of California, Livermore). Phys. Rev., 136: A108-11 (Oct. 5, 1964). (UCRL-7786)

Characteristic M-shell x rays produced when protons of 300–100-kev energy are stopped in a thick target of ytterbium were observed by proportional-counter detection. By use of an aluminum absorber, radiation originating from the filling of M_{V}-subshell vacancies can be isolated. Thick-target yields of the M_{V}-shell and $(M_{I} + M_{II} + M_{III} + M_{IV})$-shell x rays were measured separately. With extrapolated values of the fluorescence yield (0.06), the mass absorption coefficient (1500 cm^{2}/g) and the stopping power estimates of the ionization cross section for the M_{V} shell were made (neglecting contributions from other subshells by Coster-Kroning transitions). These vary from 6×10^{-26} cm^{2} at 30 kev to 2×10^{-22} cm^{2} at 100 kev. (auth)

40576 STUDY OF OSCILLATIONS AND CORRELATIONS IN THE RELAXATION OF A MODEL SPIN SYSTEM. S. P. Heims (Brandeis Univ., Waltham, Mass.). Phys. Rev., 136: A168-74(Oct. 5, 1964).

A detailed investigation is made of the approach to equilibrium of system of spins with $I = \frac{1}{2}$. The spin-spin interaction $\Sigma_{k}\ \Sigma_{j<k}\ B_{jk}\sigma_{x}^{j}\sigma_{x}^{k}$ with B_{jk} constant is treated exactly, while the additional interaction $\Sigma_{k}\ \Sigma_{j<k}\ L_{jk}\sigma_{x}^{j}\sigma_{x}^{k}$ with L_{jk} depending on lattice vibrations is treated by means of the assumption of sufficiently short correlation times for the L_{jk} operators. All correlations between the L_{jk} are included. The effect of the correlations usually neglected is expressed in terms of a sum over states somewhat resembling an Ising-model partition function with the time replacing interaction strength. The oscillatory relaxation via the B_{jk} and the monotonic relaxation via the phonons compete with each other; interference effects between the two

relaxation modes also occur; the origin and nature of the irreversibility are very different for the two relaxation modes. (auth)

40577 LEVELS IN $_{75}Re^{188}$ FROM STUDIES OF THE DECAY OF $_{74}W^{188}$ (69.4 DAY), $_{75}Re^{188}$ (18 h), AND $_{75}Re^{188m}$ (18.5 MIN). S. B. Burson, E. B. Shera, T. Gedayloo, R. G. Helmer, and D. Zei (Argonne National Lab., Ill.). Phys. Rev., 136: B1-17(Oct. 12, 1964).

Sources of ^{188}W were produced by successive capture of two neutrons in ^{186}W. A study with a double-lens spectrometer revealed the presence of a 349 ± 3-kev beta ray decaying to the ground state of ^{188}Re. A 285-kev beta-ray component to the 63.7-kev level in ^{188}Re was observed in coincidence experiments. The 59-kev beta-ray branch populating the 290.3-kev level in ^{188}Re was not directly observed. The source used for the study of the beta spectrum of ^{188}W contained an equilibrium concentration of the daughter ^{188}Re; hence, some of the properties of this latter beta decay were also examined. Scintillation and coincidence studies on sources of ^{188}W from which the daughter activity was removed chemically showed the presence of three gamma transitions: 63.7, 226.7, and 290.3 kev. The former two are found to be in coincidence. Internal-conversion-electron studies with photographic spectrographs showed lines from all of the above transitions. Scintillation measurements on the gamma spectrum of the isomeric activity in ^{188}Re showed the presence of three gamma transitions with energies of 63.7, 92.8, and 105.9 kev. The latter two gamma rays are both in coincidence with the 63.7-kev transition but not in coincidence with each other. In addition to internal-conversion-electron lines from these three transitions, spectrographic studies revealed one line at 11 kev which is interpreted as the M line of a transition of 14 ± 1.0 kev. It is concluded that the 92.8- and 105.9-kev transitions depopulate energy levels at 156.5 and 169.6 kev. All of the transitions observed in both activities, i.e., 63.7, 92.8, 105.9, 226.7, and 290.3 kev, are assigned M1 character. From this fact and a consideration of transition rates and possible spin assignments, it is concluded that both the 156.5- and 169.6-kev states have spin $I^{\pi} = 3^-$ and that the isomeric state must lie slightly above the 169-kev level (170 kev < E < 183 kev). To the extent that they overlap, both experimental results and theoretical conclusions are in agreement with the other two pertinent studies that were conducted concurrently on ^{188}W and ^{188m}Re by Roy and by Takahashi, McKeown, and Scharff-Goldhaber. The energy of 171.5 kev for the isomeric state is assumed to be the best value. The ground state and five excited states are assigned the following spins: ground state, $I = 1^-$; 63.7 kev, $I = 2^-$; 156.5 kev, $I = 3^-$; 169.6 kev, $I = 3^-$; 171.5 kev, $I = 6^-$; and 290.3 kev, $I = 1^-$. An interpretation of the level scheme is presented in terms of the spin-spin coupling model for odd-odd nuclei proposed by Gallagher and Moszkowski. All of the observed levels can be explained by various couplings of a proton in the $5/2^+$ [402] Nilsson level to a neutron in one of three different available neutron levels. The first two excited states are interpreted as members of a K = 1 rotational band based on the ground state. (auth)

40578 ISOMER Re^{188m}. K. Takahashi, M. McKeown, and G. Scharff-Goldhaber (Brookhaven National Lab., Upton, N. Y.). Phys. Rev., 136: B18-27(Oct. 12, 1964). (BNL-8074)

Two new transitions in ^{188m}Re were found which are responsible for the 18.7-min half-life of this isomer. The energies and branching ratios of these transitions which originate from a 6-state at 171.9 kev, are 2.4 kev (57%) and 15.9 kev (43%). Their multipole orders are M3. Each transition is followed by an M1 transition, of 105.9 and 92.4 kev, respectively, both terminating in the first excited (2−) state at 63.58 kev, which decays by an M1 transition to the ground state. The ground state and the first two excited states appear to be members of a rotational band with K = 1−, whereas the 3rd and 4th excited states can be interpreted as composed of the same proton orbit as that of the ground state, but of different neutron orbits. The thermal neutron activation cross section of ^{187}Re leading to the isomer was found to be 1.25 ± 0.25 b. (auth)

40579 SPIN AND MAGNETIC MOMENT OF N^{13}. A. M. Bernstein, R. A. Haberstroh, D. R. Hamilton, M. Posner, and J. L. Snider (Princeton Univ., N. J.). Phys. Rev., 136: B27-39(Oct. 12, 1964).

The spin and hyperfine structure separation $\Delta\nu$, of ^{13}N were measured by the atomic-beam magnetic-resonance technique. The atomic-beam machine was a modified focusing apparatus consisting of a six-pole A magnet, a Goodman-type C magnet, and an approximately uniform-gradient B magnet. This apparatus, which combines the high transmission of focusing machines and the smaller detector area of conventional machines, is described in detail. The ^{13}N, in the form of a gaseous molecule, was flushed continuously from the cyclotron target to the apparatus, where neutral atoms were produced in a microwave discharge in the neon carrier gas. The beam was detected on titanium foils heated to approximately 1025°C. The measurements were made in the $^4S_{3/2}$ atomic ground state, but resonances were also observed in the ^2P and ^2D metastable doublets. The final results are $I = 1/2$, as expected, and $\Delta\nu = 33.347 \pm 0.020$ Mc from a $\Delta F = 1$ measurement. Using the high-precision results on ^{14}N and ^{15}N, an average value of $|\mu_1|$ is obtained, which, corrected for shielding, is $|\mu_1| = 0.32212\ (36)$ nm. Assuming that the sign is negative (as in the case of ^{15}N), the sum of the magnetic moments of ^{13}N and ^{13}O is 0.380 nm, in agreement with the combined predictions of Kurath (for the ordinary part of the magnetic moment operator) and Sachs (for the mesonic current contributions). Further discussion of the result is given. (auth)

40580 ENERGY LEVELS FROM (d,p) REACTIONS ON Sn^{117} AND Sn^{119}. Lloyd R. Norris and C. Fred Moore (Florida State Univ., Tallahassee). Phys. Rev., 136: B40-3 (Oct. 12, 1964).

The low-lying energy levels of ^{118}Sn and ^{120}Sn were identified using the reactions $^{117}Sn(d,p)^{118}Sn$ and $^{119}Sn(d,p)^{120}Sn$. The incident deuteron beam was produced using the tandem Van de Graaff accelerator, and the resulting proton groups were detected using a broad-range Browne-Buechner spectrograph. The ground-state Q values for the two reactions were measured to be 7.09 and 6.89 Mev, respectively. Agreement with previous work is discussed. Special interest was placed on the agreement with isobaric analog work of Becker et al. (auth)

40581 DECAY SCHEME OF Rb^{83}. I. Dostrovsky, S. Katcoff, and R. W. Stoenner (Brookhaven National Lab., Upton, N. Y.). Phys. Rev., 136: B44-9(Oct. 12, 1964). (BNL-8063)

The decay of ^{83}Rb, which is reported to decay by electron capture, with emission of a single γ ray of 525 kev, to the 1.86-h isomer of ^{83}Kr was examined. With the aid of a lithium-drifted germanium detector and a high-resolution beta spectrometer it was found that the 525-kev photopeak observed with NaI crystals is really a superposition of three γ rays at 521 kev (46%), 530 kev (31%), and 553 kev (16%). An additional γ ray was found at 790 kev with intensity of 0.9%. Various coincidence experiments showed

that only the 521- and 530-kev transitions lead to the 1.86-h ^{83m}Kr. The 553- and 790-kev transitions lead to the 9.3-kev level of ^{83}Kr. Direct electron capture to this level was also observed with an intensity of 6%. The fraction of ^{83}Rb disintegrations bypassing the isomeric state of ^{83}Kr is 23%. The following new levels were assigned to ^{83}Kr: 562, 571, and 799 kev. The total disintegration energy of ^{83}Rb was shown to be ≥825 kev. (auth)

40582 OPTICAL-MODEL DESCRIPTION OF LOW-ENERGY EXCITATIONS IN NUCLEAR MATTER. C. B. Duke (Princeton Univ., N. J. and General Electric Research Lab., Schenectady, N. Y.). Phys. Rev., 136: B59-70 (Oct. 12, 1964).

The decay of single-particle excitations in nuclear matter is calculated in the low-density-gas approximation (independent-pair approximation) using a separable nucleon-nucleon interaction. For low-energy excitations this decay is describable in terms of an optical model during a time interval which is longer than 5×10^{-23} sec but shorter than 5×10^{-21} sec. In contrast to earlier calculations, the applicability of the optical model is verified and the mean energy of an excitation is computed prior to the evaluation of the optical-model parameters. Previous calculations of these parameters are shown to lead either to a circumstance in which an optical-model description of the decay is inapplicable or to an excitation whose mean energy is far off the energy shell. (auth)

40583 ELASTIC AND INELASTIC SCATTERING OF 18.4-Mev ALPHA PARTICLES FROM Na^{23}. B. T. Lucas, S. W. Cosper, and O. E. Johnson (Purdue Univ., Lafayette, Ind.). Phys. Rev., 136: B78-83(Oct. 12, 1964). (TID-20927)

Absolute differential cross sections for the elastic and inelastic (0.439- and 2.080-Mev states) scattering of 18.4-Mev alpha particles from 100-μg/cm^2 sodium tragets were measured using silicon surface-barrier detectors. The targets were prepared by the vacuum evaporation of sodium metal onto Formvar backings. The elastic and inelastic (2.080-Mev state) cross sections were measured at 2.5° intervals in the laboratory angular range from 10 to 172.5°. The 0.439-Mev state angular distribution was measured from 30 to 172.5°. The elastic cross section exhibits four evenly spaced diffraction maxima between 10 and 110°. At larger angles the pattern becomes irregular, and starts to rise rapidly at about 145°. Both inelastic cross sections exhibit pronounced forward-angle oscillatory structure and backward-angle peaking. The elastic scattering cross section was analyzed using both the simple diffraction model which yielded a best interaction radius of 6.14 F, and the five-parameter, smooth-cutoff model of McIntyre, Wang, and Becker. The inelastic cross sections were analyzed using a plane-wave Born-approximation procedure and the direct-interaction theory of McCarthy and Pursey taking $l = 2,4$ and an interaction radius of 6.3 F in each case. A Blair analysis of the inelastic cross sections yielded an average value of 0.17 for the magnitude of the quadrupole deformation parameter. An alpha-particle group corresponding to inelastic scattering from the 2.39-Mev state of ^{23}Na was observed, and the cross section was estimated to be nominally 0.1 to the (α,α_2) scattering cross section. (auth)

40584 EFFECTS OF SAMPLE SIZE AND STATISTICAL WEIGHTS ON FLUCTUATIONS IN THE $C^{12}(C^{12},\alpha)Ne^{20}$ REACTIONS. E. Almqvist, J. A. Kuehner, D. McPherson, and E. W. Vogt (Atomic Energy of Canada Ltd., Chalk River, Ont.). Phys. Rev., 136: B84-98(Oct. 12, 1964).

Absolute values of the differential cross sections for the reaction $^{12}C(^{12}C,\alpha)^{20}Ne$ to the ground and 1.63-Mev states are given at 100-kev energy intervals between 20.3- and 25.6-Mev bombarding energy at eight equally spaced angles between 3 and 73° in the laboratory, as well as some more detailed angular distributions at selected energies. Both differential cross sections and angle-integrated data are shown to fluctuate strongly with energy. A quantitative comparison between the properties of the fluctuations and the predictions of the statistical theory of the compound nucleus (used in the spirit of Ericson) is presented. The effects of making observations on a sample of finite size are illustrated in detail and are shown in some cases to lead to results that are readily mistaken for evidence of direct interaction. Fluctuations of cross sections involving sums of several incoherent components of different weights are calculated and compared with experiment and with the usual estimates based on equal weights. The proper weight coefficients for the calculation are derived from the treatment of the average cross sections. Agreement is found in all cases between observations and the statistical compound-nucleus picture although the finite-sample effects allow a contribution to the cross sections from direct reactions of 30% or less. (auth)

40585 AVERAGE CROSS SECTIONS FOR THE $C^{12}(C^{12},\alpha)Ne^{20}$ REACTIONS. E. W. Vogt, D. McPherson, J. Kuehner, and E. Almqvist (Atomic Energy of Canada Ltd., Chalk River, Ont.). Phys. Rev., 136: B99-111 (Oct. 12, 1964).

Measurements of the integrated cross sections and angular distributions of the $^{12}C(^{12}C,\alpha)^{20}Ne$ reactions, for alpha particles leaving ^{20}Ne in the ground state and first excited state, are averaged over the energy interval of 10.15 to 12.8 Mev (in the center-of-mass frame) and compared with calculations based on the statistical theory of nuclear reactions. The calculations employ optical-model transmission functions of the correct energy for each of the channels open to the compound nucleus. The applicability of the statistical theory to heavy-ion reaction is discussed. Quantitative estimates are made of the random error in calculated cross sections arising from the finite-size of the averaging interval and the cross section fluctuations in the interval. Generally good agreement is obtained between calculated and measured average cross sections for both the magnitude of integrated cross sections and the shape of angular distributions. The statistical theory calculations are combined with experimental values of total level widths to yield level spacings in ^{24}Mg, at excitation energies of 20-25 Mev. Individual level spacings for states with $J\pi = 2^+, 4^+, 8^+$ lead to estimates of the spin cutoff parameter. The corresponding value of the moment of inertia for the highly excited states of ^{24}Mg is considerably larger than that of the ground-state band. (auth)

40586 NEUTRON POLARIZATION AT SMALL SCATTERING ANGLES NEAR AN s-WAVE RESONANCE. Robert F. Redmond (Battelle Memorial Inst., Columbus, Ohio). Phys. Rev., 136: B112-17(Oct. 12, 1964).

It is shown that the neutron polarization by electromagnetic scattering at small scattering angles near an s-wave resonance may be observable at larger angles than considered previously. The angle increase possible is most pronounced at the interference minimum of the total-cross-section curve below the resonance energy. The nuclear spin-orbit polarization is also considered, and it is shown that for small-angle scattering and low energy and an assumed typical interaction strength this polarization is much less than the polarization arising from the electromagnetic spin-orbit interaction. This conclusion may be modified if the spin-orbit interaction strength is larger than that assumed because of a possible resonance be-

havior in the spin-flip scattering. The resonance behavior is indicated by a phase-shift analysis of the scattering, which also leads to the plane-wave Born-approximation result (nonresonant) under special conditions. (auth)

40587 QUASIELASTIC (p,n) ANGULAR DISTRIBUTIONS. J. D. Anderson, C. Wong, J. W. McClure, and B. D. Walker (Univ. of California, Livermore). Phys. Rev., 136: B118-25(Oct. 12, 1964). (UCRL-7735)

Previously reported neutron spectra resulting from the (p,n) reaction all showed one strong neutron group at an energy corresponding in excitation in the final nucleus to the isobaric counterpart (analog state) of the target ground state, i.e., the Q value for the reaction is the usual Coulomb displacement energy. Using time-of-flight techniques and the higher proton energies available from the 90-in. cyclotron the angular distributions of the neutrons from the isobaric (p,n) reaction for 18.5-Mev protons on 19 targets between ^{9}Be and ^{93}Nb were measured. The optical model, with the inclusion of the isospin term are suggested by Lane, is capable of explaining the diffractive nature of the (p,n) angular distributions and the absolute magnitude of the cross sections. The strength of the isospin potential (V_1) obtained from the quasielastic (p,n) reaction ($V_1 \approx 70$-90 Mev) is in agreement with the magnitude calculated from the proton potential anomaly ($V_1 \approx 100$ Mev.) (auth)

40588 PHOTONEUTRON CROSS SECTIONS OF Pb^{206}, Pb^{207}, Pb^{208}, AND Bi^{209}. R. R. Harvey, J. T. Caldwell, R. L. Bramblett, and S. C. Fultz (Univ. of California, Livermore). Phys. Rev., 136: B126-31(Oct. 12, 1964). (UCRL-7573)

Cross sections for (γ,n) and $(\gamma,2n)$ reactions on ^{206}Pb, ^{207}Pb, ^{208}Pb, and ^{209}B were measured using monochromatic gamma rays having an energy resolution of 3%. The peak cross sections for $\sigma[(\gamma,n) + (\gamma,np)]$ are 515, 475, 495, and 515 mb, respectively, and for $\sigma(\gamma,2n)$ are 76, 80, 117, and 105 mb, respectively. Integrated cross sections for $\sigma(\gamma,n)$ up to 28 Mev are 2.22, 2.05, 1.96, and 2.17 Mev-b, while for $\sigma(\gamma,2n)$ are 0.56, 0.60, 0.95, and 0.76 Mev-b, respectively. Level-density parameters for the residual nuclear ^{205}Pb, ^{206}Pb, ^{207}Pb, and ^{208}B were found to be 6.6, 13.5, 9.6, and 10.2 Mev^{-1}, respectively, each determined to ±11%. Values obtained for σ_{-2} are 15.6, 14.5, 14.1, and 16.6 mb/Mev, respectively. (auth)

40589 BINDING ENERGY OF A Λ PARTICLE IN NUCLEAR MATTER. Janusz Dabrowski and H. S. Koehler (Univ. of California, San Diego, La Jolla). Phys. Rev., 136: B162-71(Oct. 21, 1964).

The binding energy of a Λ particle in nuclear matter, $B_\Lambda(\infty)$, is calculated using a Λ-nucleon two-body potential with a hard core, which reproduces the binding energies of light hypernuclei and the Λ-nucleon scattering at intermediate energies. The simplified version of the Brueckner theory used in previous calculations is applied. The effective mass of the Λ particle, M^*_Λ, is estimated to be about 0.9 M_Λ. The rearrangement energy is included in the calculation. The result obtained, $B_\Lambda(\infty) \approx 31$ Mev, is in good agreement with the measured value. (auth)

40590 ELECTRON BREMSSTRAHLUNG IN SCATTERING BY NUCLEAR MAGNETIC MOMENTS. Patrick J. Dowling (Indiana Univ., Bloomington). Phys. Rev., 136: B171-6(Oct. 12, 1964).

The cross section for electron bremsstrahlung in the presence of a magnetic dipole potential is considered, with dependence on photon polarization explicit. Modifications of a result due to Sarkar, to include nuclear spin effects, are derived, and the angular and energy distributions of the radiated quanta are obtained. The related process of pair production is discussed. The infrared divergence is eliminated in the same way as for the Coulomb potential. (auth)

40591 NEUTRON RESONANCE SPECTROSCOPY. IV. As AND Br. J. B. Garg, W. W. Havens, Jr., and J. Rainwater (Columbia Univ., New York). Phys. Rev., 136: B177-94(Oct. 12, 1964).

The Columbia neutron velocity spectrometer with a 200-m flight path was used for total-cross-section measurements using several transmission sample thicknesses each of natural As(100% ^{75}As, I = 3/2) and Br (~50% each ^{79}Br and ^{81}Br, both I = 3/2). The values of $_g\Gamma^0_n$ for 136 levels in As (to 10 kev) and 157 levels in Br (to 4 kev) were determined. Γ_γ and J values were also determined for many of the stronger levels. The l = 0 strength function S_0 was found to be $(1.70 \pm 0.30) \times 10^{-4}$ for As and $(1.20 \pm 0.18) \times 10^{-4}$ for Br. The S_0 values are averaged over both spin states and, in the case of Br, S_0 is also averaged over the two isotopes. There were many more levels with very small values of $_g\Gamma^0_n$ for both As and Br than expected from the Porter-Thomas distribution for a single channel and a single population. The experimental value of $\langle D \rangle$ for all of the observed levels is 71 ev for As and 25.5 ev for Br. A best Porter-Thomas fit to the stronger levels alone, gives $\langle D \rangle = 87$ ev for As and 36.5 ev for Br. Assuming an approximate theoretical value of (−0.25) for the correlation coefficient between adjacent level spacings, 8 of the observed very weak. As levels and 17 of the Br levels were selected as most likely to be unreliable, or due to l = 1. Hence 128 levels for As and 140 levels for Br were used for most of the tests of statistical distribution parameters. This gives $\langle D \rangle = 75$ ev for As and 28.4 ev for Br. A considerable number of the weaker levels for each element are probably p-wave levels. Statistical analyses are given of the distributions for $_g\Gamma^0_n$, D^0, D^1, and various correlation coefficients involved the $_g\Gamma^0_n$ values and the spacings. D^0 is the nearest-neighbor level spacing, and D^1 is the next-nearest-neighbor level spacing. Comparisons are made with the predictions of various theories. (auth)

40592 INVERSE BREMSSTRAHLUNG WITH HIGH-INTENSITY RADIATION FIELDS. S. Rand (Univ. of California, San Diego, La Jolla). Phys. Rev., 136: B231-7 (Oct. 12, 1964).

The absorption of high-intensity radiation, by the inverse bremsstrahlung process, was studied. The results are significantly modified, compared to the results of perturbation theory, when the parameter $e^2E^2/m\hbar\omega^3$ becomes comparable to or greater than unity. Here E is the strength of the radiation electric field of frequency ω. It is found that the absorption cross section changes from an inverse seven-halves-power dependence on frequency for small values of the parameter, to direct proportionality for large values. Furthermore, for large radiation fluxes, the cross section varies inversely as the three-halves power of the flux. (auth)

40593 EXPERIMENTS ON THE AVERAGE CHARACTERISTICS OF CASCADE SHOWERS PRODUCED IN LEAD BY 500- AND 1000-Mev ELECTRONS. Eric E. Becklin and James A. Earl (Univ. of Minnesota, Minneapolis). Phys. Rev., 136: B237-47(Oct. 12, 1964).

The average number and the energy spectrum of shower electrons present under various thicknesses of lead were obtained with the aid of multiplate and magnetic cloud chambers. The relation between observed track length and incident electron energy was found to be incident energy (Mev) = (23.6 ± 1.6) × track length (radiation lengths). The observed number of shower electrons with energy

greater than 10 Mev is in good agreement with that predicted by recent Monte Carlo calculations; however, low-energy electrons (not included in the calculations) were found to be a large fraction of those present at large depths. Measured probabilities p_n that exactly n electrons emerge from the lower surface of a 0.75-radiation-length lead plate when one electron is incident from above are given as a function of incident electron energy. (auth)

40594 INNER-SHELL PROTON BINDING ENERGIES IN C^{12} AND Al^{27} FROM THE (e,e'p) REACTION USING 550-Mev ELECTRONS. U. Amaldi, Jr. (Istituto Superiore di Sanita, Rome), G. Campos Venuti, G. Cortellessa, C. Fronterotta, A. Reale, P. Salvadori, and P. Hillman. Phys. Rev. Letters, 13: 341-3(Sept. 7, 1964).

The binding energies of the 1p and 1s protons in ^{12}C and, particularly, ^{27}Al were observed by counting electron-proton coincidences as a function of incident electron energy, keeping the proton and scattered electron energies constant. (D.C.W.)

40595 79-DAY FERMIUM ISOTOPE OF MASS 257. E. K. Hulet, R. W. Hoff, J. E. Evans, and R. W. Lougheed (Univ. of California, Livermore). Phys. Rev. Letters, 13: 343-5(Sept. 7, 1964). (UCRL-7996-T)

A fermium isotope decaying with a half life of 79 ± 8 days, predominantly by emission of 6.56 ± 0.04-Mev alpha particles, was isolated from the products of reactor irradiation of a mixture of ^{243}Am, ^{244}Cm, and ^{242}Pu. A mass of 257 was assigned to the isotope, which has a half life for spontaneous fission of around 100 yr. (D.C.W.)

40596 ANALYSIS AND INTERPRETATION OF H^3 AND He^3 FORM FACTORS. A. Q. Sarker (Univ. of California, San Diego, La Jolla). Phys. Rev. Letters, 13: 375-7(Sept. 21, 1964).

The form factors for ^3H and ^3He are analyzed, assuming that the contributions of the meson-exchange currents to the charge form factors of these nuclei are not negligible. The exchange charge form factors are normalized to zero momentum transfer. (T.F.H.)

40597 POLARIZED PROTONS. John H. Williams. Phys. Today, 28-34(June 1964).

The production of polarized proton beams by proton scattering on ^4He and by splitting hyperfine components of hydrogen in magnetic fields is discussed. The experimental and theoretical results on the polarization of protons elastically and inelastically scattered by ^4He, ^6Li, ^{12}C, Al, Pb, Ni, ^{58}Ni, ^{60}Ni, and ^{62}Ni are reviewed. (T.F.H.)

40598 PROTON DECAY OF RADIOACTIVE NUCLEI. V. A. Karnaukhov and G. M. Ter-Akopyan. Priroda, No. 7, 60-4(July 1964). (In Russian)

The decay of unstable nuclei by proton emission is discussed. First predicted by the Soviet theoreticians Migdal, Geilikman, and Dzhelepov, and observed in Flerov's laboratory, this mode of decay is described for two conditions: simple state of low N/Z ratio when proton binding energy in the nucleus drops below zero, and positron decay of a nucleus leading again to transfer of energy to a nuclear proton. Three proton emitters with half lives of 0.8, 0.09, and 23 seconds were synthesized. All three are preceded by positron emission. The 23 second nucleus emits a 2.5-Mev proton and is either a Br or Kr nucleus whose Coulomb barrier is about 8.5 Mev. The other two emitters are light nuclei of neon and magnesium that emit protons at energies exceeding the Coulomb barrier. The low N/Z nuclei are produced in the Dubna heavy ion cyclotron. It is thought that a $^{58}Ni(^{16}O,4n)^{70}Kr$ reaction is the one that produces 2.5-Mev proton decay, while nucleon transfer reactions are thought to be responsible for the 0.8 and 0.09 second emitters. The apparatus for measuring decay energy and type of particle emitted, includes a gas cell and a semiconductor detector and is effective even in an intense background of β and γ emitters. The case of two proton decay, explored by Goldanskii is described, as are future directions for experiments with proton emitters. (TTT)

40599 THE MECHANISM OF THE REACTION $^{12}C(n,n')3\alpha$ AT 14.18 Mev NEUTRON ENERGY. T. A. Brinkley, B. A. Robson, and E. W. Titterton (Australian National Univ., Canberra). Proc. Phys. Soc. (London), 84: 201-11(Aug. 1964).

A detailed study in photoemulsions of the reaction $^{12}C(n,n')3\alpha$ excited by neutrons of energy 14.18 ± 0.05 Mev has provided information on the reaction mechanism. About 50% of the events are attributed to the mode $^{12}C(n,n')^{12}C^*$, $^{12}C^*(\alpha)^8Be^* \rightarrow 2\alpha$, most of the remainder being due to $^{12}C(n,\alpha)^9Be^*$, $^9Be^*(n)^8Be^* \rightarrow 2\alpha$ and $^9Be^*(\alpha)^5He^*(n)\alpha$. However, the reaction $^{12}C(n,{}^5He^*)^8Be^*$ cannot be excluded. Four-body break-up is unnecessary to explain the results. The 10.8 and 11.8 Mev states of ^{12}C occur in the (n,n') reaction and the data allow the assignment 1^- to the former and suggest 2^- for the latter. (auth)

40600 THERMONUCLEAR AND PYCNONUCLEAR REACTIONS. E. R. Harrison (National Inst. for Research in Nuclear Science, Chilton, Berks, Eng.). Proc. Phys. Soc. (London), 84: 213-29(Aug. 1964).

Gaseous fusion reactions are divided into two main classes, namely thermonuclear and pycnonuclear. In a gas of low density and high temperature the Coulomb-barrier penetration probability is only slightly affected by electron screening, and the main contribution to the reaction probability comes from the relatively few fast-moving nuclei at the energy E_0 of the Gamow peak. These are the temperature-sensitive thermonuclear reactions. As the density increases and the temperature decreases, the potential barriers are depressed by electron screening and the Gamow peak is increased in height and displaced toward a lower energy. At high densities and low temperatures, when the potential barriers are depressed by an amount larger than E_0, the Gamow peak is shifted across the origin and only its tail-end remains. The reaction probability is now density sensitive, and the main contribution comes from the relatively abundant slow-moving nuclei. These reactions are no longer thermonuclear and are more aptly described as "pycnonuclear." At still higher densities and lower temperatures the nuclear gas becomes degenerate and the reaction probability is independent of the temperature of the gas; these reactions are referred to as "cryonuclear." Although the results can be readily adapted and extended in the case of astrophysical applications, the main emphasis is on hydrogen-isotope reactions with the possibility in mind of achieving the controlled release of nuclear energy from dense media in the laboratory. For example, in the typical thermonuclear working region of $10^{14} < n < 10^{16}$ cm^{-3}, $10^8 < T < 10^9$ °K (where n is the ion number density and T is the temperature) the burn-up time of the nuclear fuel is the same as in the cryonuclear working region of $3 \times 10^4 < \rho < 10^5$ g cm^{-3}, $T < 10^5$ °K (where ρ is the density of the gas). A proposed classification of the gaseous fusion reactions, based on the form of the reaction probability, is as follows. The first class consists of the thermonuclear or temperature-sensitive reactions and is subdivided into the araeonuclear reactions, which are density-independent, and the pycno-thermonuclear reactions, which are density-dependent. The second class consists of the pycnonuclear

or density-sensitive reactions and is subdivided into the thermo-pycnonuclear reactions, which are temperature-dependent, and the cryonuclear reactions, which are temperature-independent and occur only in degenerate nuclear gases. (auth)

40601 THE NUCLEAR ELECTRIC QUADRUPOLE MOMENT OF ^{50}V. O. W. Howarth and R. E. Richards (Physical Chemistry Lab., Oxford). Proc. Phys. Soc. (London), 84: 326-7(Aug. 1964).

The nuclear quadrupole moment of ^{50}V has been determined. Also $\gamma(^{50}V)/\gamma(^{51}V)$ has been measured to four parts in 10^7. (auth)

40602 THE ENERGY LEVEL STRUCTURE OF ^{19}O. R. Moreh and A. A. Jaffe (Manchester Univ., Eng.). Proc. Phys. Soc. (London), 84: 330-2(Aug. 1964).

The energy level structure of ^{19}O was studied by means of the ^{17}O (t, p) reaction at an energy of 5.55 Mev, and angular distributions were measured. Energy levels at 3.223, 4.328, and 4.396 Mev were observed. It is shown that the levels at 2.775 and 3.153 Mev may be identified with the predicted $^9/_2{}^+$ and $^5/_2{}^+$ states arising from the $(d^3_{5/2})$ and $(d^2_{5/2}s_{1/2})$ configurations, respectively. (auth)

40603 THE SPIN AND PARITY OF THE 5.37 Mev LEVEL IN ^{18}O. R. Moreh, T. Daniels, and A. A. Jaffe (Manchester Univ., Eng.). Proc. Phys. Soc. (London), 84: 332-4(Aug. 1964).

The ^{17,18}O (d, p) reactions were studied at a deuteron bombarding energy of 5.55 Mev. A spin and parity of 3^+ was assigned to the 5.37 Mev level in ^{18}O by comparing the intensity of its corresponding proton group with that leading to the $^1/_2{}^+$ state at 1.47 Mev in ^{19}O. (auth)

40604 SPONTANEOUS FISSION RATES AND THE ROLE OF THE "EXCESS" NEUTRONS IN HEAVY NUCLEI. N. Feather (Univ. of Edinburgh). Proc. Roy Soc. Edinburgh, A, 66: 20-32(1961-62).

Empirical regularities are sought among the experimental data relative to the spontaneous fission rates and the nucleon-pair binding energies of the heavy even-even nuclei. Certain regularities are found; in particular it appears that the isotopic number D is a significant parameter in relation to these various quantities. The speculation is made that possibly the saddle-point deformation of the protons in the nucleus is greater than that of the neutrons. Predictions are made concerning the spontaneous fission rates of the even-even isotopes of thorium. (auth)

40605 A SEARCH FOR n-γ COINCIDENCES FROM A Po-Li NEUTRON SOURCE. R. B. Balloway (Univ. of Edinburgh). Proc. Roy. Soc. Edinburgh, A, 66: 47-52 (1961-62).

A 390-kev γ ray has been observed in coincidence with neutrons from a Po-Li source, and this has been interpreted as evidence for a level in ^{10}B at 390 kev. A search for confirmatory evidence of this γ ray has been unsuccessful, and it is estimated that such n-γ coincidences would have been detected in the experiment described if they involved 8 per cent or more of the neutrons from the Po-Li source. (auth)

40606 THE EMISSION OF LONG-RANGE ALPHA PARTICLES IN FISSION. N. Feather (Univ. of Edinburgh). Proc. Roy. Soc. Edinburgh, A, 66: 192-209(1962-63).

It is generally agreed that the long-range alpha particles of fission are set free before the fragment nuclei have acquired more than a small fraction of their final energy of separation, but whether the alpha particle is liberated before the instant of scission, at that instant, or from one of the fragment nuclei very shortly thereafter, has remained an open question. These various hypotheses are examined in relation to information regarding the distribution of mass in low-energy ternary fission, and other considerations, and it is suggested that the hypothesis having the strongest claim to attention is that which assumes that the alpha particles originate in the heavy fragments exclusively, and are liberated very shortly after the instant of scission, with probability not much less than unity, from fragment nuclei of low yield and small neutron excess. Conclusions that would follow if this hypothesis were accepted are indicated, and possible experimental tests of these conclusions are suggested. (auth)

40607 2.8-HOUR RHENIUM-190. J. Flegenheimer and G. B. Baró (Comisión Nacional de Energía Atómica, Buenos Aires). Radiochim. Acta, 2: 210-12(July 1964).

The properties of the beta and gamma radiation emitted by the 2.8-hour ^{190}Re were studied. The possibility that this activity may be due to an excited state of the nuclide is discussed. (auth)

40608 EXPERIMENTAL ASPECTS OF INELASTIC SCATTERING OF MEDIUM ENERGY ALPHA PARTICLES. H. Faraggi (Centre d'Etudes Nucleaires, Saclay, France). p.67-103 of "Lectures on Nuclear Interactions. Vol. II." [Belgrade], Federal Nuclear Energy Commission of Yugoslavia, 1962.

Approximations to the angular distribution in alpha inelastic scattering are briefly discussed, with consideration of the agreement with experimental observations. Some experimental methods are then described; and some recent experimental results on even-even isotopes of Fe, Ni, and Zn are reviewed, stressing the information obtained on nuclear structure. (D.C.W.)

40609 POLARIZATION PHENOMENA IN DIRECT REACTIONS. L. J. Goldfarb (Univ. of Manchester, Eng.). p.104-34 of "Lectures on Nuclear Interactions. Vol. II." [Belgrade], Federal Nuclear Energy Commission of Yugoslavia, 1962.

Theory for polarization effects in direct reactions is reviewed, including particle and target polarization, asymmetries due to target polarization, applications, and selection rules. Deuteron stripping is considered in detail. (D.C.W.)

40610 OPTICAL MODEL ANALYSES OF THE NUCLEAR SURFACE. P. E. Hodgson (Oxford Univ.). p.135-92 of "Lectures on Nuclear Interactions. Vol. II." [Belgrade,] Federal Nuclear Energy Commission of Yugoslavia, 1962.

The information on nuclear density distributions provided by optical model analyses is indicated, and some optical model analyses of reactions and scattering are summarized. Research on nucleon groups (deuteron, alpha particle, etc.) in nuclei is also reviewed, with consideration of studies of alpha decay, (n,α) reactions, and capture processes. 75 references. (D.C.W.)

40611 SURVEY OF RECENT EXPERIMENTAL STUDIES IN THE FIELD OF NUCLEAR FISSION. P. Armbruster (Technische Hochschule, Munich). p.193-289 of "Lectures on Nuclear Interactions, Vol. II." [Belgrade,] Federal Nuclear Energy Commission of Yugoslavia, 1962.

The probability of nuclear fission is first discussed, together with those aspects of the process that are influenced by the quantum state of the compound nucleus in the saddle point configuration. The methods and results of experimental observations on the fission products are then reviewed, and a fission model is discussed that agrees

with the data and qualitatively explains asymmetric fission. 91 references. (D.C.W.)

40612 TOTAL REACTION CROSS SECTION MEASUREMENT AND ANALYSIS. N. Cindro (Institut "Rudjer Boskovic," Zagreb). p.290-373 of "Lectures on Nuclear Interactions. Vol. II." [Belgrade,] Federal Nuclear Energy Commission of Yugoslavia, 1962.

The direct (beam attenuation) and indirect (summation of partial cross sections) methods of measuring total reaction cross sections are briefly described, and the compound nucleus and direct interaction theories of nuclear reactions are reviewed and compared with experiment. The intermediate mechanism approach is also considered. 68 references. (D.C.W.)

40613 THE SPIN CUT-OFF FACTOR AND THE ISOMERIC RATIO METHOD. G. S. Mani (Centre d'Études Nucléaires, Saclay, France). p.374-455 of "Lectures on Nuclear Interactions. Vol. II." [Belgrade,] Federal Nuclear Energy Commission of Yugoslavia, 1962.

The relation between the angular momentum distribution in excited nuclear states and the nuclear rotational energy is derived, from which an expression for the moment of inertia is obtained through the spin cut-off factor. It is shown that in the asymptotic limit of a large number of degrees of freedom, the independent-particle and liquid-drop models give the same result. Methods for determining the spin cut-off factor are then discussed, particularly the isomeric ratio method and angular distribution measurements. The statistical theory of gamma de-excitation of highly-excited states is also considered. (D.C.W.)

40614 ON THE ROLE OF THE PHOTONUCLEAR MECHANISM IN ASYMMETRIC JET FORMATION. G. T. Zatsepin and A. I. Nikishov (Lebedev Inst. of Physics, Moscow). p.26-30 of "International Conference on Cosmic Rays. Vol. 5." Bombay, Tata Inst. of Fundamental Research, 1964.

The investigation of meson jets of high energy in photoemulsions revealed a certain number of jets of an anomalous type characterized by a sharp forward asymmetry. It is suggested that a part of these sharply asymmetric jets can be explained as a result of the interaction of a nucleon or $\pi^{\pm}$ meson of high energy with the Coulomb field of the Ag and Br nuclei of the photoemulsion. A table gives values of the effective cross section for photonuclear processes on the Coulomb field of atomic nuclei with Z = 50. (A.G.W.)

40615 INVESTIGATION OF INELASTICITY AT INTERACTION OF PARTICLES WITH HEAVY NUCLEI IN 70-700 Gev ENERGY REGION. S. A. Azimov, A. M. Abdullaev, V. M. Myalkovskii, and T. S. Yuldashbaev. p.69-73 of "International Conference on Cosmic Rays. Vol. 5." Bombay, Tata Inst. of Fundamental Research, 1964.

The dependence of the inelasticity coefficient on primary energy in the 70–700 Bev energy region was investigated by a calorimeter consisting of Cherenkov counters. Seven Cherenkov counters and seven trays of hodoscope counters were placed under layers of Fe and Pb. The showers selected were generated in two Fe layers each 17 g/cm^2 thick. The average value of the inelasticity coefficient $\overline{K}_{\pi}^{Fe}$ for the interaction of $\geq 3 \times 10^{11}$ ev primaries with Fe nuclei was found to be 0.22 ± 0.02 and to remain constant with primary energy increase from 70 to 700 Bev. Data about the inelasticity of the interaction of particles with light nuclei were obtained by replacing two upper layers of Fe by a graphite block 20 g/cm^2 thick. The average value of the inelasticity coefficient $\overline{K}_{\pi}^{C}$ in the energy region above 1.5×10^{11} ev was found to be 0.16 ± 0.02. (A.G.W.)

40616 INVESTIGATION OF FRACTION OF ENERGY TRANSFERRED TO SOFT COMPONENT AT INTERACTIONS OF PARTICLES WITH CARBON NUCLEI. S. A. Azimov, Yu. V. Polyak, and R. S. Abdullaev. p.74-8 of "International Conference on Cosmic Rays. Vol. 5." Bombay, Tata Inst. of Fundamental Research, 1964.

The experimental data presented were obtained during 600 hr of work with an installation consisting of 10 trays of ionization chambers and 3 trays of hodoscopic counters placed between graphite, Pb, and Fe layers. The layers were so arranged as to record the electron-photon avalanche resulting from an interaction in the graphite generator near its maximum. The coefficient $K_{s.c.}$ of energy transmission to the electron-photon component was defined for each event as the ratio of the energy of the avalanche developed in the Pb to the energy of the particle. A figure shows the distribution of individual values of $K_{s.c.}$. The mean value of $K_{s.c.}$ was found to be 0.30 ± 0.05. (A.G.W.)

40617 ELECTRON-PHOTON COMPONENT PRODUCTION RESULTING FROM NUCLEON-NUCLEUS COLLISION. V. S. Mursin (Moscow State Univ.). p.240-7 of "International Conference on Cosmic Rays. Vol. 5." Bombay, Tata Inst. of Fundamental Research, 1964.

The results of an ionization-calorimeter study of nucleon interactions with iron nuclei are analyzed. The average multiplicity of secondary high-energy (any particle that takes away more than 15 to 20% of the primary energy) nuclear-active particles was determined to be 0.85 ± 0.08. A secondary high-energy particle took away on the average about half the primary energy. A secondary nucleon with an energy of $\geq 0.15\ E_0$ was absent in 50% of the cases. The full coefficient of inelasticity was found to be 0.75. In a brief discussion of results and theory, it is suggested that apparent contradictions can be eliminated if a strong resonant interaction of particles in the last stage of the divergence of the system is taken into account. (A.G.W.)

40618 ANALYSIS OF EXPERIMENTAL DATA ON INTERACTION OF NUCLEONS WITH ATOM NUCLEI AT HIGH ENERGIES. V. V. Guseva, S. A. Dubrovina, A. M. Lebedev, A. E. Morozov, L. A. Sanko, V. V. Sokolovskii, S. A. Slavatinskii, and B. V. Tolkachev (Lebedev Inst. of Physics, Moscow). p.349-55 of "International Conference on Cosmic Rays. Vol. 5." Bombay, Tata Inst. of Fundamental Research, 1964.

The process of interaction with complex nuclei in the energy region 10^{11}-10^{12} ev is described from the viewpoint of a series of successive statistically independent collisions of an incident particle with nucleons of the nucleus-target. Calculations of cross sections of interaction were based on the classical method of impact parameters. Results are shown for nuclei of atomic weights 6, 9, 12, 14, 16, 56, 122, and 207. The significance of the energy fraction conserved by a nucleon after interaction with a complex nucleus and the calculation of this value are discussed. Results of calculations of the probability of n-fold interactions of a nucleon in the nucleus are shown. Angular distributions of more than 200 jets produced by cosmic nucleons in photoemulsions were studied, and a parameter of anisotropy was calculated for each jet. Dependence of the anisotropy parameter on multiplicity disagrees with that expected from the hydrodynamical theory. (A.G.W.)

40619 NUCLEAR-ACTIVE PARTICLES OF COSMIC RAYS AT MOUNTAIN ALTITUDES AND CHARACTERISTICS OF THEIR INTERACTION WITH VARIOUS ATOMIC NUCLEI. K. I. Alekseeva, N. L. Grigorov, I. N. Erofeeva, L. G. Mistchenko, V. S. Mursin, I. D. Rapoport, L. I. Sarytscheva, V. A. Sobinyakov, and A. F. Titenkov. p.356-

62 of "International Conference on Cosmic Rays. Vol. 5." Bombay, Tata Inst. of Fundamental Research, 1964.

An ionization calorimeter was used to study interactions of nuclear-active particles with atomic nuclei of various elements at an altitude of 3260 m. The absolute intensity of particles with energy ≥450 Bev appeared to be $(6.0 \pm 1.0) \times 10^{-6}$/cm^2 sec sterad. If the integral spectra of nuclear-active particles are approximated by an exponential function, the exponents are 1.92 ± 0.10 for single and air-accompanied particles and 2.10 ± 0.15 for single particles. Figures show inelasticity coefficients, angular distributions of secondary particles, and a ratio between the energy transferred to photons and to $\pi^{\pm}$ mesons in each interaction. Interaction paths of nuclear-active particles were found to be 138^{+11}_{-9} g/cm^2 for Fe, 90^{+23}_{-15} g/cm^2 for graphite, and 176^{+64}_{-32} g/cm^2 for Pb. (A.G.W.)

40620 FLUCTUATIONS IN THE ANGULAR DISTRIBUTION OF SECONDARIES EMITTED IN HIGH ENERGY (≥30 Gev) NUCLEAR COLLISIONS IN CARBON. S. Lal, R. Raghavan, T. N. Rangaswamy, B. V. Sreekantan, A. Subramanian, S. C. Tonwar, and R. H. Vatcha (Tata Inst. of Fundamental Research, Bombay). p.363-7 of "International Conference on Cosmic Rays. Vol. 5." Bombay, Tata Inst. of Fundamental Research, 1964.

An experimental arrangement consisting of a multiplate cloud chamber, a total absorption spectrometer, and an air Cherenkov counter was operated for about 4000 hr at an altitude of 2.2 km to study in detail the nuclear collisions of nucleons and pions in a carbon target at energies ≥30 Bev. Results based on the study of the angular distribution of the secondaries in 250 nuclear interactions showing a total secondary multiplicity of at least 3 are presented. It is concluded that the observed fluctuations in the angular distributions of the secondaries are due to correlated emission of secondaries, probably pion resonances, giving rise to different Q-values and ratios of γ rays to charged secondaries and not due to simple motion of fire balls in the center-of-mass system. (A.G.W.)

40621 EXTREMELY COLLIMATED NUCLEAR INTERACTIONS IN CARBON INDUCED BY COSMIC RAY PARTICLES IN THE ENERGY REGION OF ABOUT 20-100 Gev. S. Lal, R. Raghavan, T. N. Rangaswamy, B. V. Sreekantan, A. Subramanian, and S. D. Verma (Tata Inst. of Fundamental Research, Bombay). p.368-72 of "International Conference on Cosmic Rays. Vol. 5." Bombay, Tata Inst. of Fundamental Research, 1964.

Twenty-five events from a previously reported group of extremely collimated nuclear interactions in C produced by charged cosmic particles were studied. It appeared that the events were predominantly produced by pions and that the particle carrying away the bulk (~80%) of the incident energy was charged. Both the average and the distribution of the transverse momenta of γ rays in these events seemed different from those of other events. A reaction proposed to explain the events involved the production of a low Q-value cloud S_n decaying into n secondaries. In cases where the cloud decayed into $2\pi^0$'s, the effective mass was calculated. The average mass found was 300 ± 10 Mev, which was considered in agreement with the reported mass of the ABC particle. Five collimated events of the same type produced by neutral particles were also studied. Three of these seemed consistent with multiple ABC production. (A.G.W.)

40622 A COMPARISON OF THE AVERAGE CHARACTERISTICS OF NUCLEAR COLLISIONS PRODUCED BY COSMIC RAY PARTICLES IN CARBON AND IN BRASS AT ENERGIES 50 Gev. S. Lal, R. Raghavan, T. N. Rangaswamy, A. Subramanian, S. C. Tonwar, and R. H. Vatcha (Tata Inst. of Fundamental Research, Bombay). p.377-81 of "International Conference on Cosmic Rays. Vol. 5." Bombay, Tata Inst. of Fundamental Research, 1964.

An apparatus consisting of a multiplate cloud chamber and a total absorption spectrometer was used to compare the average characteristics of nuclear interactions produced in carbon and in brass by charged and neutral cosmic particles of energy ≥40 Bev. The observed characteristics are tabulated. The fractional energy radiated into π^0 mesons seems to be the same for collisions in carbon and brass. There is an increase in the average multiplicity of the charged secondaries from 5.5 ± 0.3 to 7.2 ± 0.5 in going from carbon to brass. The increase in the charged multiplicity is interpreted as due to the collisions of the secondaries produced at relatively large angles in the primary collision. It may be concluded that the incident nucleon is stripped of its meson cloud in its first encounter with any one of the nucleons in the target nuclei and its mean free path for further collisions inside nuclear matter is lengthened. (A.G.W.)

40623 COMPOSITION OF THE SECONDARY PARTICLES PRODUCED IN NUCLEAR INTERACTION AT ~10^{12} ev. C. O. Kim (Univ. of Chicago). p.382-6 of "International Conference on Cosmic Rays. Vol. 5." Bombay, Tata Inst. of Fundamental Research, 1964.

Twenty-two proton, neutron, and α jets found in a 22-liter emulsion stack flown for 13 hr at 116,000 ft were analyzed to identify the nature of the particles emitted in the extreme backward center-of-mass angle cone. Of 82 secondaries, 53 were identified as π mesons, 18 as K mesons, 10 as protons, and 1 as a Y. The baryons carried the average fraction 0.5 ± 0.2 of the available energy in the center-of-mass system. The hyperon, observed to decay, had a mass of 1.69 ± 0.02 Bev and a flight time of 2.4×10^{-10} sec. The relative composition of the 82 secondaries, the average center-of-mass momenta, and the average transverse momenta showed a dependence on the center-of-mass emission angle $\bar{\theta}$. The hydrodynamical theory with a critical temperture $kT_c \cong m_\pi c^2$ predicts the correct behavior for the K/π ratio, the distribution of transverse momenta, and the average center-of-mass momenta at $\bar{\theta} < 175$. (A.G.W.)

40624 ON THE PASSING OF THE HIGH ENERGY ELECTRONS AND PHOTONS THROUGH CONDENSED MEDIA. A. A. Pomanskii. p.581-4 of "International Conference on Cosmic Rays. Vol. 5." Bombay, Tata Inst. of Fundamental Research, 1964.

Cross sections for bremsstrahlung and pair production in dense media are calculated taking into account multiple scattering and medium polarization. Results are compared with Bethe-Heitler theory. (A.G.W.)

40625 POLOLOGY AND TRIPLE ANGULAR CORRELATIONS. D. Robson (Florida State Univ., Tallahassee). 9p. (CONF-452-47)

From American Physical Society, Washington, D. C. Apr. 1964.

The correlations between the triple angular correlations in nuclear reactions in which gamma rays are emitted, and the singularities in the Born-approximation amplitudes for these reactions, are studied. (T.F.H.)

40626 γ-RAYS FOLLOWING RESONANT NEUTRON CAPTURE IN ^{177}Hf. R. H. Vogt and G. E. Holloway (Naval Research Lab., Washington, D. C.). 3p. (CONF-452-52)

From American Physical Society, Washington, D. C., Apr. 1964.

Gamma spectra from resonant neutron capture in ^{177}Hf

at 1.1 and 2.4 ev were obtained with a NaI sum-coincidence spectrometer. The source of monoenergetic neutrons was a crystal diffraction spectrometer used with a beam from the NRL reactor. Pairs of γ rays in coincidence following capture at 1.1 ev were 6.4 and 1.2, 6.13 and 1.47, 5.84 and 1.76, 5.6 and 2.0, 5.5 and 2.1 Mev; from capture at 2.4 ev: 5.4 and 1.2, and 5.6 and 2.0 Mev. (auth)

40627 $In^{113}(n,\gamma)In^{114}$ (72-SEC) AND $In^{115}(n,\gamma)In^{116}$ (13-SEC) FAST NEUTRON CROSS SECTIONS. [H. A. Grench and H. O. Menlove]. 10p. (CONF-481-79)

From American Physical Society Annual Meeting, New York, Jan. 1964.

Neutron capture cross sections of the two natural In isotopes were measured by activation techniques. Neutrons were produced by the $^{7}Li(p,n)^{7}Be$ reaction. The In was in the form of either the natural oxide or oxide enriched to 94.5% ^{113}In. Figures show results for $^{113}In(n,\gamma)^{114}In$ and $^{115}In(n,\gamma)^{116}In$ for neutron energies between about 0.3 and 1.1 Mev. The outstanding feature of the figures is the flat distribution of the points. Results for $^{115}In(n,n')^{115m}In$ show a curve almost identical with previous work on $^{113}In(n,n')^{113m}In$ but shifted in accordance with the threshold at 335 kev. Comparison of results with theoretical predictions is discussed briefly. (A.G.W.)

40628 $O^{18}(n,\gamma)O^{19}$ CROSS SECTION FROM 0.2 TO 1.0 Mev. [F. J. Vaughn, J. F. Chase, Jr., H. A. Grench, and J. W. Hilson]. 5p. (CONF-481-78)

From American Physical Society Annual Meeting, New York, Jan. 1964.

The $^{18}O(n,\gamma)^{19}O$ cross section was measured as a function of energy for neutrons between 0.2 and 1.0 Mev. Neutrons were produced by the $^{7}Li(p,n)^{7}Be$ reaction. The ^{18}O sample was in the form of water enriched to 97% ^{18}O. The decay of ^{19}O was observed, and analysis of the data gave a half life for ^{19}O of 26.27 ± 0.59 sec. Figures show the cross section for $^{18}O(n,\gamma)^{19}O$ and the total cross section of ^{18}O. Resonances were seen at 396, 475, 662, and 798 kev. (A.G.W.)

40629 THE SHELL MODEL. Maria Goeppert Mayer (Univ. of California, San Diego). Science, 145: 999-1006 (Sept. 4, 1964).

The bases and development of the shell model are reviewed, and predictions of the model are discussed in relation to experimental observations. Failures and improvements of the model are indicated. (D.C.W.)

40630 ON THE RADIATION CAPTURE OF NEUTRONS WITH THE ENERGY TO 50 kev. Yu. P. Popov. Tr. Fiz. Inst., Akad. Nauk SSSR, 24: 111-68(1964). (In Russian)

The capture cross section as a function of neutron energy was determined from the neutron slowing-down time in Pb. The neutron energy was determined from the slowing-down time of the neutron in Pb, and the capture event was fixed from the prompt gamma rays. A Zr–T target was used to generate 14-Mev neutrons by a $D(T,n)^{4}He$ reaction. Also, 24-kev photoneutrons from an Sb-Be source were used. The average capture cross section is given by the following expression: $\sigma_\gamma = k[I_\gamma/I_B(t)]\ (t + 0.3)$, where k is a normalizing factor; and I_γ and I_B are the gamma and neutron counts at slowing-down time t. Corrections for gamma-background of the spectrometer and materials of construction in the detector and sample are discussed. The various resonances found in iron, nickel, copper and lead are presented in detail. The neutron capture cross section as a function of neutron energy is also given for Br, Rb, Nb, Mo, Rh, Ag, In, Sb, I, Cs, W, Ir, and Au. The resonance absorption integrals are also tabulated for these elements and compared with literature values. The results are generally in good agreement with the other data. Nuclei with even atomic number Z have a significantly smaller capture cross-section σ_γ than nuclei with odd Z. The averaged capture cross sections were analyzed to obtain the force functions for p-neutrons as a function of the atomic weight of the target nucleus. (103 references). (TTT)

40631 STUDIES OF DEVIATIONS FROM THE 1/v LAW IN THE ENERGY DEPENDENCE OF CROSS SECTIONS OF (n,α) AND (n,p) REACTIONS ON LIGHT NUCLEI. A. A. Bergman. Tr. Fiz. Inst., Akad. Nauk SSSR, 24: 169-202 (1964). (In Russian)

The energy dependence of the cross sections of the reactions $^{3}He(n,p)$, $^{6}Li(n,\alpha)$, $^{10}B(n,\alpha)$ and $^{14}N(n,p)$ was studied for neutron energies up to 25 kev in order to investigate the structure of the excited levels in these light nuclei. A constant negative cross-section component was observed as a result of deviation from a 1/v rule. This negative component has a general character and depends only on the thermal cross section, spins, and possible contributions of two possible reaction channels to the thermal cross section. The experiments were carried out with a pulsed 14-Mev neutron source from the $D(T,n)^{4}He$ reaction in a Pb prism. Intermediate neutron energies were fixed from the slowing-down time of the neutron in Pb, as determined by the following empirical expression: $E = 183/(t + 0.3)^2$, where t is the slowing-down time in μsec. Proportional counters and scintillation counters were placed at various distances from the neutron source to measure the nuclear reaction products. Corrections were made for background, absorption, and neutron dispersion. The reaction cross sections were plotted as ratios of $^{6}Li(n,\alpha)$ to $^{10}B(n,\alpha)$, $^{6}Li(n,\alpha)$ to $^{3}He(n,p)$, and $^{14}N(n,p)$ to $^{6}Li(n,\alpha)$ as a function of the square root of the neutron energy $\sqrt{E}$, $kev^{0.5}$. These curves were found to be parabolas. The parameters of the parabolas are presented and discussed from the point of view of nuclear theory. The properties of excited levels in ^{7}Li, ^{7}Be, and ^{15}N are discussed. (TTT)

40632 ANGULAR DISTRIBUTION OF DEUTERONS WITH 13.6 Mev ENERGY ELASTICALLY SCATTERED BY SOME LIGHT AND MEDIUM NUCLEI. O. F. Nemets, F. Pikar, L. I. Slyusarenko, and V. V. Tokarevskii. Ukr. Fiz. Zh., 9: 599-609(June 1964). (In Ukrainian)

The distribution of deuterons, elastically scattered by nitrogen, oxygen, argon (gas targets), isotopes ^{63}Cu, ^{65}Cu, ^{84}Sr, ^{86}Sr, ^{87}Sr, ^{88}Sr, ^{107}Ag, ^{109}Ag, and ^{116}Sn, ^{118}Sn, ^{120}Sn, ^{122}Sn, and ^{124}Sn was investigated. A selective scintillation spectrometer, selecting particles according to the (dE/dx)E method, was used as a detector. It was found that unlike the elastic scattering of protons, the isotopic effects are expressed very weakly. The dependence of the position of extreme points of differential cross sections of elastic scattering on the atomic number A was plotted, including also the data of the preceding measurements performed at an energy of 13.6 Mev. It also was found that both the maximum and the minimum change their position systematically and smoothly. In the region of atomic numbers $A \simeq 50$ anomalies are observed. In addition, depending on A the change of $\delta(\theta)/\delta_R(\theta)$ is regular for each of extremity. Both these regularities allow predicting the angular distributions for deuterons with an energy of 13.6 Mev elastically scattered by some nuclei not yet investigated. (OTS)

40633 INELASTIC SCATTERING OF DEUTERONS BY ZINC AND ZIRCONIUM. V. V. Tokarevskii and Yao Liang (Kiev Inst. of Physics). Ukr. Fiz. Zh., 9: 610-16(June 1964). (In Ukrainian)

The angular distributions of 13.6-Mev deuterons in-

elastically scattered by Zn and Zr nuclei were measured. Besides the single-phonon quadrupole 2^+ (T = 0) and single-phonon octupole 3^- (T = 0) states, a peak was found during inelastic scattering of deuterons by zinc with Q = 1.7 ± 0.2 Mev corresponding to excitation of a two-phonon triplet of even zinc isotopes. (auth)

40634 EFFECT OF CLOSE-RANGE ORDER IN LIQUIDS ON COMPLETE SECTIONS OF INTERACTIONS OF COLD NEUTRONS. V. P. Vertebnyi, I. P. Dzyub, A. P. Maistrenko, and M. V. Pasechnik. Ukr. Fiz. Zh., 9: 684-5(June 1964). (In Ukrainian)

The results from measurements of total cross sections in liquid and gaseous nitrogen and liquid oxygen in the region 4-15 Å are presented. The cross sections for the liquids were very different from those for the gaseous phase. The variation of the cross section in the liquids resembled Bragg discontinuities in neutron cross sections in crystals for $\lambda = 2d_{max}$. It was shown that the decrease in cross section for $\lambda \geq 5.5$ Å is associated with the existence of close-range order in liquids. (tr-auth)

40635 EXCITATION FUNCTIONS OF THE (α,γ) AND (α,n) REACTIONS ON TIN ISOTOPES. D. E. Khulelidze, V. L. Chikhladze, M. Z. Maksimov, and V. G. Onufriev. Zh. Eksperim. i Teor. Fiz., 47: 393-9(Aug. 1964). (In Russian)

The excitation functions for $^{112}Sn(\alpha,\gamma)^{116}Te$, $^{112}Sn(\alpha,n)^{115}Te$, and $^{114}Sn(\alpha,n)^{117}Te$ reactions are measured for particle energies between 10 and 20 Mev. The peak values of the cross sections are, respectively, 8, 54, and 290 mb. The cross sections for the (α,γ) reaction are very large. The cross sections are calculated on basis of the compound nucleus model. The probability for γ-quantum emission is calculated in the single particle approximation as well as with the aid of formulas which take into account the structure of the giant resonance. In the latter case agreement with the experiments is much better. (auth)

40636 NEUTRON POLARIZATION IN THE $T(d,n)He^4$ REACTION. N. V. Alekseev, U. R. Arifkhanov, N. A. Vlasov, V. V. Davydov, and L. N. Samilov. Zh. Eksperim. i Teor. Fiz., 47: 433-8(Aug. 1964). (In Russian)

Polarization of neutrons from the $T(d,n)^4He$ reaction is measured for E_d between 9 and 19 Mev. Scattering on a gas (helium) scintillator connected in coincidence with two neutron counters was employed as the analyzer. In order to exclude geometric asymmetry effects the neutron spin was rotated through an angle of 90° in the longitudinal magnetic field of a solenoid. Maximum polarization is observed at an angle $\theta_{l\,lab} = 30°$ and, in a broad energy range, exceeds 50%. Resonance effects in the energy dependence of neutron polarization were detected which are related to the excited states of the ^{5}He nucleus (16.7 and 20 Mev). (auth)

40637 THE TIME CORRELATION FUNCTION TECHNIQUE AND ITS APPLICATION TO THE THEORY OF MÖSSBAUER LINE SHIFTS AND DEFORMATION. M. V. Kazarnovskii and A. V. Stepanov (Lebedev Inst. of Physics, Moscow). Zh. Eksperim. i Teor. Fiz., 47: 543-57(Aug. 1964). (In Russian)

Interaction between an arbitrary type of radiation (particles, light quanta) and complex systems (molecules, liquids, etc.) is discussed with the aim of elucidating the following questions: what information on the structure and dynamics of a complex system can be derived from an analysis of data on the effect of the system on the probing radiation and conversely, and what characteristics of the complex system must be known in order to predict the results of such an action? It is shown that the time correlation function formalism (TCF) is convenient for this purpose. In the particular case when interaction between the radiation and system can be described by the Born approximation the results obtained are the same as thus obtained by Van Hove. The main properties of the TCF corresponding to various types of probing particles and their interaction with the system under investigation are considered. It is shown, in particular, that in the general case the TCF is complex and becomes real only if recoil of the system under investigation is neglected, which is equivalent to transition to the classical limit ($\hbar \to 0$). If the system is in thermal equilibrium the real and imaginary parts of the TCF are connected by relations which follow from the Nyquist theorem. The formalism developed is extended to the case when decay effects in the initial state are important. As an application, the shift and deformation of γ quantum resonance non-recoil absorption and emission lines due to differences in the hamiltonians of atomic motion in the ground and excited states in the Mössbauer nuclei are considered. Integral relations are obtained which connect the probability of the Mössbauer effect (as a function of temperature) with the shape of the Mössbauer line. It is shown that in the presence of preferred degrees of freedom in the atomic system, the Mössbauer line may not only broaden but also become sharply distorted. (auth)

40638 ANALYSIS OF ELASTIC SCATTERING OF He^3 AND α PARTICLES ON BASIS OF THE OPTICAL MODEL OF THE NUCLEUS. V. Z. Goldberg, V. P. Rudakov, and I. N. Serikov. Zh. Eksperim. i Teor. Fiz., 47: 571-6(Aug. 1964). (In Russian)

The differential cross sections for elastic scattering of ^{3}He on a number of nuclei are calculated on basis of the optical model of the nucleus. It is shown that the experimental data in a broad range of nuclei from ^{9}Be to ^{209}Bi can be satisfactorily described by a single set of optical potential parameters. The potential parameters for elastic scattering of ^{3}He and α-particles on ^{27}Al are compared. (auth)

40639 ANGULAR DISTRIBUTION OF THE POLARIZATION OF ELASTICALLY SCATTERED FAST DEUTERONS. V. T. Ippolitiov. Zh. Eksperim. i Teor. Fiz., 47: 627-31(Aug. 1964). (In Russian)

Elastic scattering of deuterons on complex nuclei is considered. Formulas for the vector and tensor polarizations are derived by employing the approximation of high energies and small angles and assuming that the spin-orbit part of the scattering phase shift is small. The results are compared with available experimental data, and the parameters characterizing the optical potential of the deuteron are determined. (auth)

40640 ANNIHILATION OF POSITRONS IN ALKALI METAL HYDRIDES. V. I. Goldanskii, A. V. Ivanova, E. P. Prokopev (Inst. of Chemical Physics, Academy of Sciences, USSR). Zh. Eksperim. i Teor. Fiz., 47: 659-66(Aug. 1964). (In Russian)

A new interpretation of the time distribution of annihilation radiation in alkali metal hydrides is presented. It is shown that the presence of two components in the positron lifetime spectrum in the hydrides is due to annihilation at different excited levels of the e^+H^- system. The possible existence of a third component corresponding to annihilation at the ground level is predicted. The self-consistent field technique is employed for calculating the stationary states of the e^+H^- bound system and the main annihilation characteristics. (auth)

40641 REGGE POLES AND RESONANCE NUCLEAR REACTIONS. [PART] II. E. I. Dolinskii and V. S. Popov

(Inst. of Theoretical and Experimental Physics, Erevan). Zh. Eksperim. i Teor. Fiz., 47: 697-707(Aug. 1964). (In Russian)

Formulas for the proper resonance level asymmetry in the angular distribution of the reaction products which appears when the compound nucleus resonances are described as moving Regge poles are derived by taking into account Coulomb interaction. Results of numerical calculation of the asymmetry are presented for elastic resonance scattering of α-particles on the ^{12}C nucleus at energies up to 5 Mev. (auth)

40642 PRODUCTION OF π-MESON PAIRS BY HIGH-ENERGY NEUTRINOS ON NUCLEI. Yu. P. Nikitin and E. P. Shabalin (Moscow Inst. of Engineering Physics). Zh. Eksperim. i Teor. Fiz., 47: 708-14(Aug. 1964). (In Russian)

Differential and total cross sections for the process $\nu + A \rightarrow \mu^- + \pi^+ + \pi^0 + A$ for small transferred momenta are obtained on basis of Coulomb and diffraction mechanisms. It is shown that the diffraction mechanism dominates for neutrino energies $E \lesssim 60$ Bev. Comparison with experiments in principle may yield information on the magnitude of the cross sections for the processes $\nu + \pi^- \rightarrow \mu^- + \pi^0$ and $\gamma + \nu \rightarrow \mu^- + \pi^+ + \pi^0$. (auth)

40643 SCATTERING OF RADIOWAVES BY A POINT SOURCE OF LONG-RANGE RADIATION IN AIR. Yu. A. Medvedev. Zh. Tekhn. Fiz., 34: 1083-5(June 1964). (In Russian)

It is shown that the region around a point source of gamma radiation in air scatters incident radio waves. Trajectories of the radio waves are calculated. The difference between the occurrence of scattering in the earth's ionosphere and in the corona of the sun is noted. (tr-auth)

40644 RADIOAKTIVNYE EMANATSII. (Radioactive Emanation). V. M. Permyakov. Moscow and Leningrad, Publishing House of the Academy of Sciences, 1963. 176p.

The physical and chemical properties of ^{222}Rn, ^{220}Rn, and ^{219}Rn are discussed. These include decay spectra, half life, absorption, diffusion, chemical effects, units of activity and concentration, and other properties. The properties and activity of ^{218}Po, ^{214}Pb, ^{214}Bi, ^{210}Po, ^{210}Bi, ^{210}Pb, ^{215}Po, ^{211}Pb, ^{211}Bi, ^{216}Po, ^{212}Pb, ^{212}Bi, ^{212}Po, and ^{208}Tl are also briefly discussed. A bibliography of 442 references is included. (C.E.S.)

40645 NUCLEAR PHYSICS. Second Edition. Irving Kaplan. Addison-Wesley Series in Nuclear Science and Engineering. Reading, Mass., Addison-Wesley Publishing Company, Inc., 1963. 782p.

Topics in nuclear physics are reviewed, including: the history of atomic and nuclear physics; x radiation and its relation to atomic structure; the quantum theory of radiation; the special theory of relativity; fundamental nuclear properties (constituents, isotopes, etc.); radioactivity, nuclear decay, and induced disintegrations; nuclear reactions; nuclear forces and structure; neutron physics; fission; nuclear energy sources; and charged-particle accelerators. (T.F.H.)

40646 LECTURES ON NUCLEAR INTERACTIONS. VOLUME I. DELIVERED AT THE SEVENTH SUMMER MEETING OF NUCLEAR PHYSICISTS, AUGUST 1962, HERCEG-NOVI, YUGOSLAVIA. Branislav Lalović, ed. [Belgrade], Federal Nuclear Energy Commission of Yugoslavia, 1962. 392p. [$4.00.]

Separate abstracts were prepared for the five lectures included. (D.C.W.)

For abstracts of individual lectures see: 40355, 40356, 40647, 40648, and 40649.

40647 PROBLEMS OF NUCLEAR STRUCTURE. Victor Weisskopf (CERN, Geneva). p.1-32 of "Lectures on Nuclear Interactions. Vol. I." [Belgrade], Federal Nuclear Energy Commission of Yugoslavia, 1962.

Difficulties in the theory of nuclear reactions and structure are outlined, with consideration of specific nuclear models. (D.C.W.)

40648 FEW NUCLEON PROBLEMS AND THE PROBLEM OF NUCLEAR FORCES. I. Šlaus (Institut "Rudjer Bošković," Zagreb). p.51-343 of "Lectures on Nuclear Interactions. Vol. I." [Belgrade], Federal Nuclear Energy Commission of Yugoslavia, 1962.

A review of experiment and theory on two-nucleon interactions, the bound state of three nucleons, nucleon-deuteron interactions, nucleon–triton and nucleon–^3He interactions, nuclear reactions of light nuclei, and charge dependence of nuclear forces is presented. 570 references. (D.C.W.)

40649 NEUTRON–NEUTRON INTERACTION AND CHARGE INDEPENDENCE OF NUCLEAR FORCES. K. Ilakovac (Institut "Rudjer Boškovic," Zagreb). p.344-62 of "Lectures on Nuclear Interactions. Vol. I." [Belgrade], Federal Nuclear Energy Commission of Yugoslavia, 1962.

Some tests of the charge independence of nuclear forces are reviewed, including analyses and observations of N-N scattering and interactions with two neutrons and another particle in the final state. (D.C.W.)

40650 LECTURES ON NUCLEAR INTERACTIONS. VOLUME II. DELIVERED AT THE SEVENTH SUMMER MEETING OF NUCLEAR PHYSICISTS, AUGUST 1962, HERCEG-NOVI, YUGOSLAVIA. Branislav Lalović, ed. [Belgrade], Federal Nuclear Energy Commission of Yugoslavia, 1962. 461p. [$4.00].

Separate abstracts were prepared for the seven lectures included. (D.C.W.)

For abstracts of individual lectures see: 40608, 40609, 40610, 40611, 40612, 40613, and 40651.

40651 INELASTIC EXCITATION OF COLLECTIVE LEVELS. J. S. Blair (Univ. of Washington, Seattle). p.1-66 of "Lectures on Nuclear Interactions. Vol. II." [Belgrade], Federal Nuclear Energy Commission of Yugoslavia, 1962.

Theory for collective excitation in inelastic scattering is reviewed, including the adiabatic theory (particularly the Fraunhofer version) and the extended optical model. The connection between the adiabatic and distorted-wave theories is also considered. (D.C.W.)

Plasma Physics and Thermonuclear Processes

Refer also to abstracts 40119 and 40424.

40652 (AD-436464) IONIZATION PROCESSES IN HYDROGEN. [Period Covered], February–March 1964. R. D. Hill (Illinois. Univ., Urbana and Stanford Research Inst., Menlo Park, Calif.). Contract Nonr-2728(00). 10p.

Ionization and associated processes in H_2 gas were studied with reference to production of large electron densities in plasma. The 4-Mev 100-amp electron beam of the Livermore Astron experiment was used in the calculations. It is found that the average energy of the ionization electrons, before collision with H_2 gas, is ~3 ev and that they will thermalize in ~0.2 μsec. The electron plasma density is calculated to be 1.8×10^{12} and 7.1×10^{12} cm^{-3} at pressures of 1 and 10 mm Hg, respectively, for a 100-amp

electron beam of 1 cm radius. Plasma conductivities and eddy current heating are considered. (D.L.C.)

40653 (AD-600845) OPERATING POINTS AND STABILITY LIMITS OF A HIGH PRESSURE DIRECT CURRENT PLASMA ARC. S. D. Raezer (Johns Hopkins Univ., Silver Spring, Md. Applied Physics Lab.). Mar. 1964. Contract NOw 62-0604-c. 33p. (CM-1043)

Procedures employed in determining the operating points and stability limits of the APL split-ring, 10-megawatt plasma arc are described. General solutions are obtained and the numerical procedure for mapping areas of arc operation is described. (auth)

40654 (AFCRL-64-67) ELECTRON INTERACTIONS IN CRYOGENIC HELIUM PLASMAS. Scientific Report No. 1. P. D. Goldan, J. H. Cahn, and L. Goldstein (Illinois. Univ., Urbana. Electrical Engineering Research Lab.). Dec. 1963. Contract AF19(628)-3307. 154p. (AD-600045)

Electron interactions in decaying helium afterglow plasmas, maintained near 5°K, were determined from electronic microwave conductivity measurements. Experiments were performed for neutral densities in the range 2×10^{17} to 2×10^{19} atoms/cc. Concurrently, electron temperatures were inferred from microwave noise radiation from the afterglow plasma and microwave interaction measurements. (auth)

40655 (AFCRL-64-412) STUDIES AND INSTRUMENTATION FOR ACCELERATING PARTICLES IN A PLASMA. Final Report. Joseph G. Kelley, Allen G. Rubin, and Ivan A. Nichols (Williamson Development Co., Inc., West Concord, Mass.). May 29, 1964. Contract AF19(628)-309. 29p. (AD-600761)

The Plasma Betatron is discussed. Transient optical measurements are discussed. An image converter camera was incorporated into the existing experiments. Infrared devices, particularly a laser interferometer, were designed. A 6 inch arc driven shock tube facility was planned, set up, and placed in operation. Significant modifications to the vacuum system and the high-voltage system were completed. Various instrumentation problems are discussed. The conclusions reached in each of these phases are presented. Appendices present theoretical details for two experiments—the infrared interferometer and the plasma conductivity measurement. (auth)

40656 (CLM-Bib-5) MAGNETIC MIRROR MACHINES. A Bibliography. L. S. Francis, comp. (United Kingdom Atomic Energy Authority. Research Group. Culham Lab., Culham, Abingdon, Berks, England). Feb. 1964. 42p.

A total of 504 references covering a period from 1954 to 1963 on nuclear fusion devices and experiments that use magnetic mirror geometry is given. Cusp geometries are also included. Indexes are for author, subject, report numbers, and journal titles. (R.E.U.)

40657 (CONF-471-34) COLLISIONLESS PLASMA SHEATHS WITHOUT TRAPPED PARTICLES. Richard L. Morse (California. Univ., San Diego, La Jolla). [1963]. Contract [AT(11-1)-34]. 34p.

From American Physical Society 5th Annual Meeting, San Diego, Calif., Nov. 1963.

The sheath of a collisionless field-free plasma is treated by an extension of the charge-neutral approximation and by numerical integration of the exact equations. It is doubtful that physically acceptable solutions exist without trapped particles in the sheath, if the distribution of particle velocities is isotropic or near isotropic. Acceptable solutions are, however, found where the relative velocity of the sheath and plasma is large compared to the thermal spread of particle velocities in the plasma rest frame. These solutions are shown. It is also shown that these solutions go over smoothly to the Rosenbluth case as the thermal spread goes to zero. (auth)

40658 (IPPJ-26) A SOLENOID WITH SINUSOIDAL WINDINGS FOR IOFFE FIELD. Shigeo Nagao (Nagoya, Japan. Univ. Inst. of Plasma Physics). Mar. 1964. 8p.

The application of Ioffe fields to a stationary plasma device was examined briefly from the technical point of view. (auth)

40659 (IPPJ-27) SCATTERING OF MICROWAVES FROM A PLASMA COLUMN IN RECTANGULAR WAVEGUIDES. Hideo Ikegami (Nagoya, Japan. Univ. Inst. of Plasma Physics). Apr. 1964. 57p.

The microwave reflection method for the measurement of various parameters of cold plasma is examined. The exact solutions are obtained for the waves scattered by a plasma column inserted in the duct. The probing electric field of TE_{10} mode is parallel to the axis of the column. Emphasis is placed on the fact that inhomogeneous electron density distribution is fully taken into account. The electron density in the column is assumed to be $n(r) = n_0[1-(r^2/\rho^2)]$, where ρ is the radius of the column and n_0 is the electron density on the axis of the column. The electric permeability is then locally defined with use of n(r). Numerical calculations of reflection coefficients are carried out with the electronic computer IPP OKITAC-5090 and their results are tabulated for such parameters as ω_p/ω, ν/ω, ka, and kρ for practical convenience. The electron densities in a positive column determined by the microwave reflection method with use of the tables are compared with those determined by the Langmuir probe method. The comparison is found in satisfactory agreement. (auth)

40660 (NASA-TN-D-2476) RESONANT INTERACTION OF VERTICALLY POLARIZED PLANE ELECTROMAGNETIC WAVES WITH THIN SLABS OF PLASMA. Paul D. Rowley and Virginia L. Sorensen (National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.). Sept. 1964. 25p.

An obliquely incident vertically polarized plane electromagnetic wave may interact in a resonant manner with a thin slab of plasma if the collision frequency is small and the frequency of the incident wave is approximately equal to the plasma frequency. Particular examples of this phenomenon are considered in detail. For most boundary conditions for a homogeneous slab the reflection coefficient taken as a function of frequency tends to follow a circle in the complex plane when near this resonant condition. The numerical solutions and the extent to which the results are applicable to real plasma are discussed. (auth)

40661 (NP-14233) A SPECTROSCOPIC STUDY OF A DECAYING HYDROGEN PLASMA. F. E. Irons and D. D. Millar (Sydney. Univ. School of Physics). Apr. 1964. 31p. (ER-8)

A study was made of hydrogen plasma decay with an ion density of $\sim 3 \times 10^{15}$ cm^{-3} and a temperature of $\sim 10^4$ °K. Details are presented of the experimental methods used to determine density and temperature distributions in the decaying plasma. The plasma decays by three-body recombination mainly and the experimental values of the recombination coefficient agree with those expected for a plasma opaque to the Lyman-α radiation. The loss of thermal energy from the plasma is mainly by thermal conductivity. (auth)

40662 (SIT-131) ON THE STABILITY CONDITIONS OF FLUTE INSTABILITY. Special Report. George Schmidt (Stevens Inst. of Tech., Hoboken, N. J.). [1963]. Contract AT(30-1)-2813. 16p.

A simple treatment of flute instabilities, including finite Larmor radius effects, is presented. The results of Lehnert and Rosenbluth, et. al., (except for a factor 2 in one term) are rederived from a unified standpoint. The physical mechanism of the stabilizing effects is discussed. Some generalizations of interest to radiation belts and thermonuclear research are undertaken. The dispersion relation for arbitrary values of β shows that the use of the $\beta = 0$ dispersion relations is sometimes over-optimistic in treating laboratory plasmas with finite values of β, especially in fast θ pinches undergoing large accelerations. For most mirror machines (steady state), however, the $\beta = 0$ results of Rosenbluth, et. al., give the correct results for the overall stability limit. (auth)

40663 (SIT-131-A) EXTENDED STABILITY CRITERION FOR MINIMUM-B GEOMETRIES. Special Report. George Schmidt (Stevens Inst. of Tech., Hoboken, N. J.). [1964]. Contract AT(30-1)-2813. 5p.

A general necessary and sufficient stability condition against any instability is derived from the stability criterion for minimum-B configurations against interchange instabilities. Plasma motion is viewed as motion of the "phase fluid" in (α,β,μ,J) space. (R.E.U.)

40664 (SSD-TDR-64-122) STUDY OF TURBULENCE IN AN ARC PLASMA JET USING ELECTROMAGNETIC INDUCTION. A. E. Fuhs (Aerospace Corp., El Segundo, Calif.). Aug. 3, 1964. Contract AF04(695)-269. 34p. (TDR-269(4280-50)-1)

The interaction of a turbulent conducting gas with a steady applied magnetic field drives fluctuating currents. The unsteady magnetic field arising from these currents induces a voltage e in a sensing coil. An integral equation for e and the related partial differential equation for the electrical potential ϕ are derived. A relation between signal rms magnitude and jet properties is discussed. Experiments were conducted using an arc plasma jet operating with argon. Most of the signal was due to frequency components in the interval 10 to 100 kc. By use of two transducers, one located downstream of the other, the average jet velocity was measured. The delay giving the peak value of the cross correlation function formed from the two signals was taken as the transit time. Methods for electronically determining the time delay are described. (auth)

40665 OSCILLATIONS IN SINGLE AND COLLIDING PLASMAS. R. Mirman (Long Island Univ., Brooklyn). Am. J. Phys., 32: 690-9(Sept. 1964).

The study of a few idealizations of plasma oscillations, such as the electrostatic, electromagnetic, and hydromagnetic modes, illustrates the behavior of vibrations in a plasma. The dispersion relations for each type are derived and their significance is discussed. Further consideration is given to electrostatic modes of interacting streams with a brief mention of instability growth and decay. (auth)

40666 THE ACCELERATION FACTOR OF THERMONUCLEAR REACTIONS IN A HIGHLY COMPRESSED HYDROGEN PLASMA. Jean-Louis Bobin (CEA, Paris). Compt. Rend., 259: 77-9(July 6, 1964). (In French)

The lowering of the potential barrier due to electrons was determined. The acceleration factors and the mean reaction times under stellar conditions were calculated. (tr-auth)

40667 POST-LUMINESCENCE OF ATOMIC LINES OF HYDROGEN INTRODUCED AS AN IMPURITY IN RARE GASES. Andre Ricard (Sud-Aviation DT/CS, Courbevoie, France). Compt. Rend., 259: 89-92(July 6, 1964). (In French)

The abnormal post-luminescence of hydrogen as an impurity in a pulse-excited He or Ne plasma was studied. The characteristic parameters of the phenomenon—intensity and time constant—depend on the nature and proportions of the mixture and on the dimensions of the sample and the zone observed. (tr-auth)

40668 A CONDITION OF THERMODYNAMIC CLOSURE FOR THE SYSTEM OF HYDRODYNAMIC EQUATIONS IN A COLLISIONLESS PLASMA IN MAXWELLIAN EQUILIBRIUM. Daniel Quemada (Faculte des Sciences, Orsay, France). Compt. Rend., 259: 315-18(July 15, 1964). (In French)

For the case of a collisionless plasma in Maxwellian equilibrium, a thermodynamic-type relation between the conductivity and the thermoelectric coefficient was derived for each species of particle with electric charge. In the absence of an external magnetic field or in the case of perturbations propagating along the magnetic field, the relation is a condition of exact closure for the system of hydrodynamic equations derived from the Vlasov equation. (tr-auth)

40669 FREQUENCY SHIFT AND DAMPING OF INTERACTING LANGMUIR OSCILLATIONS. G. I. Suramlishvili. Dokl. Akad. Nauk SSSR, 157: 83-7(July 1, 1964). (In Russian)

The interaction between elementary excitations in a condensed medium leads to an energy shift and damping of the excitations due to energy transfer between harmonics. This problem is investigated for Langmuir oscillations or 1-plasmons with wave vector $k \ll R_D^{-1}$, where $R_D = \sqrt{T/4\pi e^2 n}$ is the Debye radius. A 4-plasmon process is the only allowed process for 1-plasmons in order to conserve energy and momentum. One 1-plasmon is scattered by another 1-plasmon in this process. The full Hamiltonian of the Langmuir oscillations is written with secondary quantization. The damping is given by the following expression: $Q_k^{(2)}(\Omega_k) \sim (\Omega_0/N_D^2)(kD_D^2)$, where N_D is the number of particles in the Debye sphere and Ω_k is the energy of the plasmon. The frequency broadening is also of the order of $Q_k^{(2)}$ and can be readily calculated. (TTT)

40670 STATISTICAL THEORY OF NONEQUILIBRIUM PROCESSED IN PLASMA (ALLOWANCE FOR NONLINEAR INTERACTION OF WAVES IN KINETIC EQUATIONS). Yu. L. Klimontovich (Moscow State Univ.). Dokl. Akad. Nauk SSSR, 157: 563-5(July 21, 1964). (In Russian)

The kinetic equations for a plasma with a nonlinear wave interaction being taken into account are considered for two limiting cases. First, the average fields are equal to zero. With this condition, the variation in the charged-particle distribution function f_a is completely determined by correlations of the chance deviations of the phase density δN_a, and of the electric and magnetic fields δE and δB. With a quasistationary approximation for the field, the spectral functions are eliminated from the equation for f_a, and as a result, a closed set of kinetic equations for the function f_a are obtained that take into account the nonlinear wave interaction. Secondly, the correlations of the chance deviations can be completely neglected. With this condition the equations of Vlasov are valid. A quasilinear approximation for these equations is considered that takes into account the congruent interaction of the waves. In the general case, equations describing the con-

gruent and incongruent wave interaction are obtained. In particular, the process of the appearance and development of the average field excited by the chance field can be described by these equations. (TTT)

40671 FUNDAMENTAL EQUATIONS OF MAGNETIC GASDYNAMICS OF A NONISOTHERMAL PLASMA. M. F. Shirokov. High Temp., 1: 346-52(Nov.-Dec. 1963). Translated from Teplofiz. Vysokikh Temp., 1: 386-93 (Nov.-Dec. 1963).

The principles of irreversible thermodynamics are used to provide a set of equations for the magnetogasdynamics of a nonisothermal low-pressure gas-discharge plasma which constitute a complete set, i.e., the number of unknowns equals the number of equations. Moreover, particle creation and annihilation and the dissipative processes of internal friction and thermal conductivity are taken into account in these equations. The equations demonstrate the incorrectness of the conventional equations for the magnetogasdynamics of a nonisothermal plasma considered as a homogeneous medium. (auth)

40672 MEASUREMENT OF TEMPERATURES IN FLAMES, GAS FLOW, AND PLASMAS FROM SPECTRAL LINE INTENSITIES. V. V. Kandyba (Khar'kov State Univ.). High Temp., 1: 386-90(Nov.-Dec. 1963). Translated from Teplofiz. Vysokikh Temp., 1: 431-6(Nov.-Dec. 1963).

Flame-temperature measurement methods are discussed in relation to low-temperature dense plasmas. (auth)

40673 METHODS FOR AUTOMATIC COMPENSATION OF THE EMISSION COEFFICIENT IN MEASURING THE PLASMA TEMPERATURE WITH RESPECT TO RADIO-FREQUENCY THERMAL RADIATION. G. L. Iosel'son (Khar'kov State Univ.). High Temp., 1: 391-5(Nov.-Dec. 1963). Translated from Teplofiz. Vysokikh Temp., 1: 437-42(Nov.-Dec. 1963).

Methods for measuring the temperature of plasma with respect to its radio-frequency thermal radiation are presently used to an ever increasing extent. This is connected with the possibility of measuring the electron temperature of heavily ionized media and high-temperature gas flow. Radiometers are used for measuring weak radio-frequency thermal radiation whose intensity is at or below the level of the instrumental noise of the receiving equipment. The radiated power is usually measured by using the method of comparison with the radiation of a standard black radiator, thus eliminating the errors connected with the indeterminancy of the passband. In measurements based on the method of equalizing the power received and the power of the standard radiator, the errors connected with fluctuations in the sensitivity of the receiving device are eliminated. If the above factors and the parameters of the receiving antenna are accurately taken into account, even low radiation intensities can be measured fairly accurately. The absorption coefficient must be measured without exerting an influence on the configuration of the object, and, therefore, the reflectometric method must be used. (N.W.R.)

40674 STUDY OF ARC PLASMATRON OPERATION. V. B. Tikhomirov and I. V. Varlamov. Inzh. Fiz. Zh., Akad. Nauk Belorussk. SSR, 7: 16-19(June 1964). (In Russian)

On the basis of the assumptions adopted, an equation is obtained whose solution gives a value of a plasma temperature on the channel axis of the arc plasmatron. The experimental check of some calculation results has shown a satisfactory coincidence. The current distribution along the channel length of the arc plasmatron is studied, and maximum axial temperatures are calculated for some operating conditions of the arc plasmatron. (auth)

40675 THE WAVE EQUATION AND THE GREEN'S DYADIC FOR BOUNDED MAGNETOPLASMAS. Y. J. Seto and Arwin A. Dougal (Univ. of Texas, Austin). J. Math. Phys. (N. Y.), 5: 1326-34(Sept. 1964).

In studies of electromagnetic wave propagation and radiation in magnetoplasmas, the wave equation takes the form of a dyadic-vector Helmholtz equation. The investigation shows that the dyadic-vector Helmholtz equation is solvable by the separation method in four cylindrical coordinate systems. Solutions in the form of complete sets of eigenfunctions are possible when boundary surfaces are present. For problems involving current sources in the plasma, the Green's dyadics for finite or semifinite domains can be constructed from the complete sets of eigenfunctions which are solutions to the homogeneous equation. The Green's dyadic for infinite domain is also shown to be obtained from that for a semifinite domain through a limiting process. (auth)

40676 INSTABILITY IN A COLD CATHODE REFLEX DISCHARGE. G. Briffod, M. Gregoire, and S. Gruber (Centre d'Etudes Nucleaires de Saclay, Gif-sur-Yvette, France). J. Nucl. Energy, Pt. C, 6: 329-38(July-Aug. 1964).

The behavior of a low-pressure cold-cathode reflex discharge was studied to determine the nature of the instability that appears in the presence of a d-c magnetic field. It was found that electric fields at a frequency of 5 Mc were generated by the plasma and were of intensity sufficient to modify the plasma and so stop these oscillations. The plasma then relaxed to a state where the instability reappeared. It was also determined that the effect of the radial d-c electric field on the instability was negligible. If one assumes that an adequate model of the reflex discharge is that of a cold plasma column filled with a fast beam of primary (ionizing) electrons, it can be shown that the solution of the dispersion relation shows growing waves for the measured plasma parameters. (auth)

40677 REVIEW OF EXPERIMENTS ON THE DIFFUSION OF PLASMA ACROSS A MAGNETIC FIELD. F. Boeschoten (Institut für Plasmaphysik, Garching, Ger.). J. Nucl. Energy, Pt. C, 6: 339-88(July-Aug. 1964).

Experiments to determine whether the diffusion of plasma across a magnetic field is determined only by collisions between the plasma particles or whether other more complicated effects contributed are reviewed. (C.E.S.)

40678 A.C. CONDUCTIVITY OF A PLASMA. C. S. Shen and R. L. W. Chen (Goddard Inst. for Space Studies, New York). J. Nucl. Energy, Pt. C, 6: 389-99(July-Aug. 1964).

The electric conductivity of a fully ionized, spatially homogeneous plasma under the influence of a uniform, periodically alternating electric field is calculated. The velocity distribution of the electrons is determined by solving the linearized Fokker–Planck equations. All the terms in the collision integral are retained, including those representing electron–electron interactions. The resultant values of conductivity is expected to be valid in the range of frequencies from zero to below the plasma frequency. (auth)

40679 A STUDY OF RADIATION-INDUCED SHOCK WAVES EXTERNAL TO QUARTZ DISCHARGE TUBES AND ASSOCIATED FRACTURE PROBLEMS. R. C. Elton (Naval Research Lab., Washington, D. C.). J. Nucl. Energy, Pt. C, 6: 401-4(July-Aug. 1964).

The existence of a shock wave generated in the air surrounding a quartz T-type electromagnetic shock tube is

discussed. The large amount of radiant energy emitted in the ultraviolet spectral region from the ~2 ev plasma in the T-tube suggested that the absorption of this radiation might be responsible for initiating the external shock wave. A detailed investigation of the mechanism responsible for this phenomena is reported. (C.E.S.)

40680 ON HELIUM PLASMA THROUGH NEUTRON IRRADIATION. J. Braun (Aktiebolaget Atomenergi, Studsvik, Nykoping, Sweden). J. Nucl. Energy, Pt. C, 6: 407-11 (July-Aug. 1964).

It is shown that a technically feasible plasma can be generated in a mixture of a noble gas and ^{3}He by neutron irradiation. If this is done in a reactor, this plasma should have a sufficient life to be of practical value in a MHD channel with realizable flow data. (C.E.S.)

40681 UNIFIED THEORY OF RELAXATIONS IN PLASMAS. IV. GENERAL COLLISION TERMS. Naobumi Honda (Tokyo Univ.). J. Phys. Soc. Japan, 19: 1201-6 (July 1964).

Exact quantum mechanical calculation of collision cross sections is performed yielding results which, for $\hbar \to 0$, reduce to those of classical calculation. Effects of particle identity are also investigated. (auth)

40682 HYDRODYNAMIC FLUCTUATIONS AND CORRELATIONS IN A PLASMA. Setsuo Ichimaru (Tokyo Univ.). J. Phys. Soc. Japan, 19: 1207-12(July 1964).

The dielectric response function of a non-drifted two-component plasma in the absence of a magnetic field is calculated in the framework of the macroscopic diffusion equations, and its properties are investigated. The dynamic form factor $S(k,\omega)$ is then evaluated, which may give a proper description of correlations in large distances and long time separations; the behavior of the poles of $S(k,\omega)$ in the complex ω-plane is studied, and the nature of the correlations is clarified. Certain experimental connections are also discussed. (auth)

40683 PRELIMINARY RESULTS ON ELECTRON ACCELERATION MECHANISM IN THE SLOW THETA PINCH. Kazuo Sata, Haruyuki Ohnishi, and Hisamitsu Yoshimura (Nihon Univ., Japan). J. Phys. Soc. Japan, 19: 1244-5(July 1964).

Hard x rays with maximum energies of 300 kev were observed in a slow Θ pinch. Helium gas without preheating was discharged by the mirror coil which consists of two multiturn coils connected parallelly. No reverse field was applied initially. The peak magnetic field at the mirrors of 25 kgauss was reached in 60 μsec. An attempt was made to determine the electron acceleration mechanism. (C.E.S.)

40684 COHERENT INTERACTIONS OF A MODULATED ELECTRON BEAM WITH A PLASMA (HXR-4). Takayoshi Yamamoto, Hideo Akimune, and Tokuo Suita (Osaka Univ.). J. Phys. Soc. Japan, 19: 1250(July 1964).

The amplification of microwave modulation on an electron beam by passing it through a plasma was investigated. It is shown how the gain of the maximum amplification depends upon the velocity of the electron beam. A hydrogen plasma was used, and the dependence of the maximum gain on the beam velocity for various plasma densities is shown. (C.E.S.)

40685 A SPECTROSCOPIC STUDY OF THE THERMODYNAMIC STATE OF ARGON IN A CONICAL ELECTROMAGNETIC SHOCK TUBE. John A. Thornton and Ali Bulent Cambel (Northwestern Univ., Evanston, Ill.). J. Quant. Spectr. Radiative Transfer, 4: 539-57(July-Aug. 1964).

Time resolved spectroscopic experiments are described in which the average thermodynamic state across the diameter of the accelerated argon plasma generated in a 3-in.-dia conical type electromagnetic shock tube was determined at ambient pressures of 50 μ, 300 μ, and 1 mm Hg and at positions of 15.25, 20, and 35.5 cm downstream from the ring electrode. Luminous front velocities ranged from 0.25 to 1 cm/μsec, temperatures from 13,000 to 18,000°K, and peak electron densities from 10^{16} to 10^{17} cm^{-3}. The data indicate complete thermodynamic equilibrium. In all tests the temperatures were significantly higher than those predicted by the shock equations assuming a cold gas ahead of the luminous front. Microwave transmission measurements indicate that the electron density ahead of the luminous front is less than 5×10^{10} cm^{-3}. It is concluded that luminosity of the kind observed is from the driver plasma or a mixture of the driver and driven plasmas, depending on the ambient pressure, and that the thermodynamic state of the accelerated plasma must therefore be determined experimentally. (auth)

40686 THEORY OF PLASMAS IN ROTATING MAGNETIC FIELDS. I. LANGEVIN EQUATION. T. Kirsten (Karl-Marx-Universität, Leipzig) and G. Vojta. Kernenergie, 7: 451-6(June-July 1964).

The behavior of a plasma in a rotating transversal magnetic field, in a constant axial magnetic field, or in a constant axial electric field was studied on the basis of the single-particle theory with consideration of friction. As a starting point the Langevin equation was solved for different cases. The trajectories of the particles in a rotating magnetic field were established and optimum frequency conditions were determined for the confinement of the plasma by a rotating magnetic field. (auth)

40687 THEORY OF PLASMAS IN ROTATING MAGNETIC FIELDS. II. KINETIC THEORY. T. Kirsten (Karl-Marx-Universität, Leipzig) and G. Vojta. Kernenergie, 7: 457-62(June-July 1964).

Starting from the Boltzmann equation, the kinetic theory for a Lorentz plasma in a rotating magnetic field was developed. The Boltzmann equation was solved by series expansion, and the diffusion, thermal diffusion, and conductivity tensors were calculated. The problem of plasma confinement by a rotating magnetic field is discussed. (auth)

40688 THEORY OF PLASMAS IN ROTATING MAGNETIC FIELDS. III. MOTION OF CHARGED PARTICLES IN A RADIAL ELECTRIC FIELD WITH ADDITIONAL MAGNETIC FIELDS. H. Pfau (III Physikalisch-Technisches Institut, Berlin), G. Vojta, and R. Winkler. Kernenergie, 7: 463-9(June-July 1964).

The motion of a charged electron in a homopolar ixion or magnetron field configuration was investigated, taking into account the friction of the particles involved in the plasma or neutral gas. The motion equation was solved for this problem by assuming a strong axial magnetic field. A series expansion is given for the solution of the motion problem for the case of the ixion field configuration with a superimposed homogeneous magnetic field rotating in the plane perpendicular to the cylinder axis. It was assumed that the electron moves between two coaxial metal cylinders An analog computer was used in the calculations. (auth)

40689 THEORY OF PLASMAS IN ROTATING MAGNETIC FIELDS. IV. SIMPLE MAGNETOHYDRODYNAMIC THEORY. E. Lorenz (III Physikalisch-Technisches Institut, Berlin), E. Hantzsche, G. Vojta, and R. Winkler. Kernenergie, 7: 469-74(June-July 1964).

The linearized equations of plasma dynamics were solved for a completely ionized, quasi-neutral, homogeneous plasma under the influence of a space-independent, rotating

magnetic field and a constant electrical field perpendicular to the magnetic field. The time-dependence of the velocity and the current density of the plasma are discussed for high rotational frequencies and weak magnetic fields under different initial conditions. (auth)

40690 STATISTICAL DERIVATION OF ADIABATIC EQUATIONS OF STATE FOR PLASMAS. I. PLASMAS WITH SINGLY IONIZED ATOMS AND DISSOCIATING DIATOMIC MOLECULES. G. Vojta (Arbeitsstelle für Statistiche Physik, Leipzig, der Deutschen Akademie der Wissenschaften zu Berlin) and E. Kirsten. Kernenergie, 7: 475-81(June-July 1964).

By the methods of statistical thermodynamics, thermal equations of state for adiabatic processes were derived for a classical plasma with singly ionized atoms and/or with dissociating diatomic molecules. These equations have a closed form and imply only the thermodynamic parameter pressure and temperature and, in addition, the energy of ionization or dissociation of a particle. Thermodynamic equilibrium is assumed and radiation effects and correlation of particles are not taken into consideration. As examples argon (up to 2×10^4°K) and hydrogen were considered over a pressure range from 10^{-2} to 10^5 atm. The limits of validity of the approximations made are discussed and ways for treating plasmas with degenerate electron component and plasmas with arbitrary composition are given. (auth)

40691 EXPERIMENTS WITH AN INDUCTIVE-HYDRODYNAMIC SHOCK TUBE. L. Rothhardt (Institut für Magnetohydrodynamik, Jena, der Deutschen Akademie der Wissenschaften zu Berlin). Kernenergie, 7: 481-5(June-July 1964).

The shock tube used was a pill-box shaped glass chamber with a long cylindrical expansion tube attached to its center and filled with hydrogen between 0.1 and 1 Torr. Measurements were made of the total light, as a function of time, emitted from the chamber as well as from the expansion tube from which shock and associated plasma velocities of up to 4×10^6 cm per second were derived. Electric plasma conductivities were measured in the expansion tube by applying external voltage to two probes 20 cm from the chamber. Experiments with probes in different positions showed that hydrodynamical boundary phenomena strongly affect the relation between probe voltage and current in the probe circuit. (auth)

40692 TECHNICAL PROBLEMS IN PLASMA PHYSICS. W. Anger (Kernforschungsanlage, Julich, Ger.). Kerntechnik, 6: 361-7(July-Aug. 1964). (In German)

Technical problems in the confinement and heating of plasmas are discussed, particularly the principles of construction and design of discharge circuits for energy storage with extremely low inductance. The fundamentals of a magnetic compression experiment are described, and problems that are connected with the discharge of a number of energy storage devices on a common load are explained. Methods for the prolongation of rapidly rising high magnetic fields are also considered. (D.C.W.)

40693 GENERALIZED OHM'S LAW IN A MAGNETIC PLASMA. Iván Abonyi, Zsuzsa Koevesy, and János Szabo (Loránt Eötvös Univ., Budapest). Magy. Fiz. Folyoirat, 12: 45-57(1964). (In Hungarian)

The variation of the flux density of a plasma confined by a magnetic field as a function of time is obtained by applying the generalized Ohm's law. The behavior of the plasma is given by the two-fluid theory, relating it to the hydrodynamic velocity. The properties of the ideal plasma were investigated for the case in which the external fields may have any arbitrary position with respect to each other and the initial flux density may also assume any desired value. The solution was obtained by means of Laplace transforms. The results agreed with previously reported values. (TTT)

40694 THE COURSE OF TEMPERATURE CHANGES DURING A LINEAR PINCH-DISCHARGE. W. Muller (Arbeitsstelle fur Statistische Physik der Deutschen Akademie der Wissenschaften, Leipzig). Monatsber. Deut. Akad. Wiss, Berlin, 6: 486-91(1964).

The course of temperature changes in a simple pinch model was investigated theoretically under the assumption that the plasma produces Joule-type heat and that it emits both recombination and moderating radiation. Adiabatic conditions were considered. The individual processes contributing to temperature changes are discussed and conclusions regarding the development of a constant pinch radius, spatial distribution of the particle-size density, attainable plasma temperature, and effects of the magnetic field of the plasma itself are described. (OTS)

40695 CONTAINMENT OF PLASMA IN A MAGNETIC MIRROR, WITH HEXAPOLE STABILIZING FIELDS. G. Francis, D. W. Mason, and J. W. Hill (Atomic Energy Authority, Abingdon, Berks, Eng.). Nature, 203: 623-4 (Aug. 8, 1964).

A hydrogen plasma produced by a coaxial gun was injected into a static converging magnetic field that increased smoothly from 450 Oe to 4.3 kOe over 3.5 m length, remained uniform over a further distance of 2 m (the central trapping region) and beyond that decreased symmetrically to 450 Oe. The fast plasma moved adiabatically along the field from the gun into the central trapping region. The slow plasma was prevented from following it by the sudden application of pulsed magnetic fields opposite to the guide field, at points 75 cmm and 170 cm from the gun. The decay of the plasma, although smooth, was some four times faster than would be expected from charge exchange on the background gas at the measured base pressure. When the amount of injected plasma was reduced by a limiter with a small hole, the decay time of the trapped plasma increased from about 250 to 400 μsec; also, when the diverting fields were not used, the fast plasma disappeared abruptly when the slow plasma arrived. Thus, the residual plasma-loss rate observed with the hexapole fields excited is qualitatively consistent with a charge exchange mechanism. (P.C.H.)

40696 SPECTROSCOPIC INVESTIGATION OF A PULSED HIGH-FREQUENCY DISCHARGE IN HELIUM. I. Ya. Fugol, P. L. Pakhomov, and G. P. Reznikov. Opt. Spectry. (USSR) (English Transl.), 16: 510-13(June 1964). Translated from Optika i Spektroskopiya, 16: 941-8(June 1964).

The luminescence kinetics of helium plasma in a pulsed electrodeless high-frequency discharge were investigated at different powers and temperatures at pressures from 0.1 to 40 mm. The decrease in line intensity during the high-frequency (HF) pulse at 290°K is explained on the basis of the atom recombination mechanism. At 77°K, de-excitation and an intense afterglow were observed in a number of HeI lines. In order to explain the afterglow at 77°K, reference is made to dissociative recombination of molecular ions. The metastable 2^3S helium atoms play an important role in the formation of these ions. The time constants of helium gas discharge plasma glow were determined. (auth)

40697 CONTINUOUS ABSORPTION COEFFICIENT OF A HYDROGEN–CARBON PLASMA AT A TEMPERATURE

OF 40,000°K AND A PRESSURE OF HUNDREDS OF ATMOSPHERES. N. N. Ogurtsova, I. V. Podmoshenskii, and V. M. Shelemina. Opt. Spectry. (USSR) (English Transl.), 16: 514-18(June 1964). Translated from Optika i Spektroskopiya, 16: 949-57(June 1964).

An isothermal hydrogen–carbon plasma at T = 40000°K and at pressures of 120 and 500 atm was obtained by means of a high-power capillary discharge. The spectral coefficient of continuous absorption of the plasma under these conditions was measured. The measurement was made by two independent methods: by transillumination of the plasma with a brighter light source and by measurement of the absolute value of the intensity of the radiation from a plasma layer of given depth. In the measurements in the long-wavelength region of the spectrum, a ruby laser was used as the transilluminating source. A comparison of the experimentally measured absorption coefficients with a theoretical calculation of the continuous absorption for free-free and free-bound transitions was made. Certain peculiarities of the radiation of the plasma at high pressures are pointed out. (auth)

40698 NONLINEAR INTERACTION OF LIGHT IN A PLASMA. P. M. Platzman (Bell Telephone Labs., Murray Hill, N. J.) and N. Tzoar. Phys. Rev., 136: A11-16(Oct. 5, 1964).

The elastic scattering of light off light in the presence of a plasma is investigated. The cross section for this process is expressed in terms of matrix elements of the charge-density operator between exact eigenstates of the many-body system (plasma). The cross section is evaluated to the lowest order in the plasma parameter $r_s \equiv (n/q_d^3)^{-1}$. A study of the dependence of the differential cross section on momentum and energy transferred in the scattering will allow one to measure the plasma dielectric functions. Although the cross sections are small, the development of intense light sources (lasers) makes a measurement feasible. (auth)

40699 ION ACOUSTIC WAVES IN AN ELECTRON CYCLOTRON RESONANCE PLASMA. J. L. Shohet (Johns Hopkins Univ., Baltimore). Phys. Rev., 136: A125-6 (Oct. 5, 1964).

Ion acoustic waves were generated in an electron cyclotron resonance plasma. The plasma was produced in a long microwave cavity at the heating frequency of 3.025 Gc. When the resonance condition $\omega_p^2 = 2\omega(\omega - \omega_b)$ is approached, the plasma constricts, corresponding to present theory. The waves appeared when the magnetic field was increased slightly above the value necessary to achieve the resonance condition. The waves were observed by means of a photomultiplier, a Langmuir probe, and a shift in frequency of a higher order cavity mode. Harmonics of the waves up to and including the 4th were seen. (auth)

40700 PROPAGATION OF LONGITUDINAL ELECTROMAGNETIC WAVES IN MONONUCLEAR PLASMA. Jozef Szpilecki. Postepy Fiz., 15: 61-78(1964). (In Polish)

The properties of longitudinal electromagnetic waves in plasma are treated in a simplified manner, making use of the kinetic theory which takes the effect of the collisions into consideration, and treating the problem from the viewpoint of the quasihydrodynamic theory. The high-frequency, or plasma, waves, and low-frequency waves, known as acoustic waves in an isotropic medium and as magnetohydrodynamic waves in an anisotropic medium, are discussed. Results derived from two theories are compared. Kinetic theory indicates large occlusions in the neighborhood of the resonance areas. From the study of the longitudinal wave formation at the plasma–dielectric interface, it is concluded that an angle of about 10° between the electric field vector and the incident plane represents the most advantageous condition for the formation of such waves. (TTT)

40701 DETERMINATION OF THE TEMPERATURE OF THERMAL PLASMA BY SPECTRAL METHODS. Albin Czernichowski. Postepy Fiz., 15: 173-89(1964). (In Polish)

Although the temperature of thermal plasma does not exceed 5×10^4 °K, the large number of plasma components and the lack of thermodynamic stability of the system present many problems. Spectral methods were found useful for this type of investigation. One of the first such methods involved the determination of the intensity of the spectral lines as a function of the temperature. Methods involving the determination of the relative intensities of two or more spectral lines make it possible to measure temperatures up to 4×10^4 °K by using ionic line spectra; the results do not depend on the composition or the pressure of the plasma. Determination of the relative intensity of a single spectral line and measurements concerning the intensity distribution in a molecular spectrum yield information on the temperature in the 1.5×10^4 and 10×10^4 °K ranges, respectively. Temperature data may be also obtained from the description of the profile of the spectral lines (at about 1.8×10^4 °K), reversal of the spectral lines (at about 4000°K), and from measurement of their width, together with the analysis of the electric continuum. For all these measurements, the thermodynamic state of the system must be known. No precise values can be expected from calculations derived from the determination of the plasma composition, total pressure, electric charge, external electric and magnetic fields, the mean free paths of the component particles, or the number of collisions or energy transfers during collisions. (TTT)

40702 THE GENERALIZED VALIDITY OF THE BOLTZMANN EQUATION FOR IONIZED GASES. Toyoki Koga (Univ. of Southern California, Los Angeles). Proc. Intern. Symp. Rarefied Gas Dyn., 3rd, Paris, 1962, 1: 75-93(1963).

It is suggested that, in kinetic equations for plasmas, the effect of the inner core field induced by a charged particle within the Landau distance is, in most practical cases, larger than the effect of the weak field outside the Landau distance. The predominant effect is represented by collision terms of the Boltzmann type. The criterion of rarefaction of plasmas is considered. The incoherent radiation phenomena are neglected. (auth)

40703 ON THE CURRENT COLLECTED BY A CHARGED CIRCULAR CYLINDER IMMERSED IN A TWO-DIMENSIONAL RAREFIED PLASMA STREAM. Frederick O. Smetana (Univ. of Southern California, Los Angeles). Proc. Intern. Symp. Rarefied Gas Dyn., 3rd, Paris, 1962, 2: 65-91(1963).

Assuming that the concentration of ions and electrons near a small, charged cylinder in a plasma stream does not alter the symmetry of the force field appreciably, one can determine the trajectory of any particle in the stream when under the influence of this field, provided the motion is collisionless. By summing over all particle velocities in the undisturbed stream (one may take a Maxwell-Boltzmann distribution) it is possible to find the number of orbits which intersect the cylinder. This depends among other things upon the radial extent of the field. When the field extends more than 10 cylinder radii, the flux varies but slightly with changes in field extent. The same is true when the

field extent is very small. For intermediate field extent considerable error can result if the value is not known reasonably well. An approximate Poisson equation is developed and solved and this appears to yield errors in the flux no larger than 10%. The results of the numerical integrations for the cylinder current are presented graphically. (auth)

40704 THE USE OF LANGMUIR PROBES IN LOW DENSITY PLASMA FLOWS. J. B. French, A. A. Sonin, and J. H. DeLeeuw (Univ. of Toronto). Proc. Intern. Symp. Rarefied Gas Dyn., 3rd, Paris, 1962, 2: 471-94(1963).

An experimental study of Langmuir probes that are small in relation to neutral particle mean free paths is presented. The probes were studied in a moderately supersonic plasma stream at high and low ion concentrations. Probe theory is reviewed and extended, and by comparison with experiment it is indicated that these small probes can be used for the determination of plasma properties when care is exercised in ascertaining the conditions to which the probe is subjected. In particular, the charged particle mean free paths in terms of the probe size and the ratio of electron-to-ion temperature are of importance. The probes were used in the study of the stagnation region in front of a blunt body. (auth)

40705 GENERALIZED MAGNETOHYDRODYNAMIC EQUATIONS FOR NONEQUILIBRIUM PLASMA SYSTEMS. Willis L. Everett (Univ. of Michigan, Ann Arbor). Proc. Intern. Symp. Rarefied Gas Dyn., 3rd, Paris, 1962, 1: 1-25 (1963).

Generalized magnetohydrodynamic equations, obtained from velocity moments of the Boltzmann equations, are closed out by utilizing Grad 13-moment approximations for the distribution functions. These representations for the distribution functions differ from those previously utilized in that the independent variable in the Hermite polynomial expansion is taken to be the particle velocity relative to the mean velocity of that type particle, rather than relative to the mean mass velocity of the plasma; giving rise to distributions which have first terms Maxwellian relative to constituent flow velocity, rather than Maxwellian relative to mean mass flow velocity of the plasma. The range of validity of the resulting magnetohydrodynamic equations is anticipated to extend to systems in which the constituents of the plasma are not close to thermodynamic equilibrium with each other. Transport relations were extracted from these equations for some limiting cases of interest. (auth)

40706 GRAZING INCIDENCE SPECTRA OF HIGHLY IONIZED ATOMS FROM LABORATORY PLASMAS. B. C. Fawcett, A. H. Gabriel, B. B. Jones, and N. J. Peacock (Atomic Energy Research Establishment, Abingdon, Berks, Eng.). Proc. Phys. Soc. (London), 84: 257-62(Aug. 1964). (CLM-P-40)

Radiation from high temperature plasmas produced in the Zeta and Thetatron discharges has been studied down to the soft x-ray region using grazing incidence spectrographs. Two forms of instrument have been used, one designed for laboratory studies and the other for solar observation from rockets. Both employ 600 line/mm ruled gratings at grazing angles between 1 and 4°. The resonance line of Ne IX at 13.44 Å is the shortest wavelength observed. New spectra are reported from Ne VII, Ne VIII, Ar IX, Ar X, Ar XI, Ar XII, and Xe IX. (auth)

40707 REFLECTION OF AN ELECTROMAGNETIC WAVE AT THE OPEN END OF A WAVEGUIDE. S. S. Kalmykova (Khar'kov State Univ.). Ukr. Fiz. Zh., 9: 593-8 (June 1964). (In Ukrainian)

Diffraction of a surface wave propagated along a cylinder plasma waveguide at the open end of the latter is discussed. Formulas are derived for surface wave reflection and generation in the case of the waveguide radius exceeding the skin depth and less than the wavelength in vacuum. (auth)

40708 HIGH-SPEED PLASMA BEAMS IN VACUUM ARCS. A. A. Plyutto, V. N. Ryzhkov, and A. T. Kapin. Zh. Eksperim. i Teor. Fiz., 47: 494-507(Aug. 1964). (In Russian)

Results of investigation of high speed plasma beams in stationary vacuum arcs are presented. The mean energies of ions of metals of the first group (Mg, Al, Ni, Cu, and Ag) are 20 to 40 ev. The presence of significant quantities of doubly and triply charged ions of metals of the second group in the plasma is established spectroscopically. The concept of a potential hump in the cathode spot region is introduced to explain the origin of the high speed plasma beams. (auth)

40709 ON THE INTERACTION BETWEEN CHARGED PARTICLES AND A TURBULENT PLASMA. I. A. Akhiezer (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Zh. Eksperim. i Teor. Fiz., 47: 667-77(Aug. 1964). (In Russian)

The interaction between charged particles and a plasma consisting of cold ions and hot electrons moving relative to the ions with a velocity exceeding that of double-temperature sound is investigated. The rate of energy and momentum change due to emission and absorption of turbulent sound oscillations is determined. It is shown that the details of the turbulency spectrum do not affect the dependence of the indicated quantities on particle velocity or direction of motion. The level of turbulent fluctuations determine only the overall coefficient in the expressions for energy and momentum transfer. The energy of a particle moving in a plasma will decrease if the particle velocity v satisfies the condition $vu > s^2$ (u is the mean directed electron velocity, s is the velocity of double-temperature sound); the particle energy will increase if $vu < s^2$. The rate of change of the particle energy is proportional to the effective temperature of the turbulent oscillations, T, provided the value of vu lies between $s^2 \mp (u^2 - s^2)^{1/2} (v^2 - s^2)^{1/2}$. Near the boundaries of this region the energy varies as $T^{1/2}$. If $v \approx u$ or $v \approx s$ (and $vu \approx v^2$) the rate of particle energy losses is proportional to T^2. Interaction between charged particles and turbulent oscillations of other types is also considered, e.g., with high frequency electron or short wave ion oscillations. (auth)

40710 INVESTIGATION OF A DISCHARGE WITH HEATED CATHODE IN A MAGNETIC FIELD. V. E. Golant, M. V. Krivosheev, and V. E. Privalov (Leningrad Polytechnic Inst.). Zh. Tekhn. Fiz., 34: 953-60(June 1964). (In Russian)

Results are described from an experimental study of an incandescent cathode discharge in a uniform magnetic field in argon with discharge currents to 25 amp, magnetic field intensities to 2500 Oe, and pressures from 3×10^{-3} to 1 mm Hg. Experimental results are in qualitative agreement with theoretical estimates. At discharge current density around 50 amp/cm^2, pressure of 0.1 mm Hg, and magnetic field of 2500 Oe, a charged particle concentration in the plasma on the order of 10^{15} cm^{-3} was obtained. (tr-auth)

40711 APPLICATION OF MICROWAVE METHOD FOR DETERMINING SUPERCRITICAL ELECTRON CONCENTRATIONS. V. E. Mitsuk and V. D. Sizov (Moscow State Univ.). Zh. Tekhn. Fiz., 34: 961-4(June 1964). (In Russian)

A method is described, which allows an electron density significantly higher than the critical to be measured by the usual microwave technique. A cylindrical configuration of plasma, confined in a right-angle waveguide, is studied. For a homogeneous dielectric target, an expression for the dielectric permeability in terms of the electric potentials is derived. A relation between the phase shift and the coefficient of transmission or reflection is obtained for the nonhomogeneous case. The phase shift, wave damping, and drop in electron density during deionization were measured, using pulse discharge in neon. The time dependence of the phase shift and the coefficient of transmission were recorded. The experimental time dependence of the electron-density drop is given and compared with results from the known theory of nonstationary processes. The faster experimental drop is explained by the effect of inelastic collisions of the first kind, not accounted for by the theory. (M.J.T.)

40712 STRUCTURE OF MAGNETIC FIELDS IN PLASMA JET WITH INTRINSIC CURRENT. Yu. V. Skvortsov, V. S. Komel'kov, and S. S. Tserevitinov. Zh. Tekhn. Fiz., 34: 965-73(June 1964). (In Russian)

Results of studies carried out during 1959–61 are presented. The glass discharge chamber used is described, and the effects of electrode polarity are considered. The magnetic fields within the plasma jet, determining the stability and region of acceleration of the plasma clusters, were investigated. The properties and structure of the current pinch were studied. The process of abruption of the jets from the electrodes and the plasma jet velocity as a function of the discharge parameters were considered. (M.J.T.)

40713 ABSORPTION OF HIGH-FREQUENCY ENERGY BY PLASMA NEAR ION CYCLOTRON RESONANCE. I. M. P. Vasil'ev, L. I. Grigor'eva, V. V. Dolgopolov, B. I. Smerdov, K. N. Stepanov, and V. V. Chechkin. Zh. Tekhn. Fiz., 34: 974-83(June 1964). (In Russian)

Cyclotron absorption of the electromagnetic waves excited by currents flowing in a coil around a plasma cylinder is studied. The heating of the plasma during cyclotron excitation of strongly damping (frequent) and weakly damping (infrequent) waves is considered. General expressions for the absorbed plasma energy are derived, and boundary conditions are investigated. (M.J.T.)

40714 EXPERIMENTAL INVESTIGATION OF ABSORPTION OF HIGH-FREQUENCY ENERGY BY PLASMA NEAR ION CYCLOTRON RESONANCE. [PART] II. M. P. Vasil'ev, L. I. Grigor'eva, V. V. Dolgopolov, B. I. Smerdov, K. N. Stepanov, and V. V. Chechkin. Zh. Tekhn. Fiz., 34: 984-92(June 1964). (In Russian)

Absorption of h-f energy by a dense plasma ($n \sim 10^{13}$ cm^{-3}) was studied in the region of ion cyclotron resonance. The density and temperature of the plasma and the h-f power excited in the plasma were measured. The variation of the absorbed power with the magnetic field intensity and the plasma density was obtained. Results are in agreement with theory. (tr-auth)

40715 INTERACTIONS OF PLASMA FLUXES MOVING TOWARDS EACH OTHER ALONG THE AXIS OF AN INDUCTION PINCH. M. D. Gabovich and I. M. Mitropan. Zh. Tekhn. Fiz., 34: 993-7(June 1964). (In Russian)

A counter axial movement of the plasma currents is present in an induction pinch. For certain conditions, a strong interaction of the currents can be observed. A discharge was excited in a glass pipe filled with hydrogen. A capacitor battery of 10 μf, charged to potentials from 20 to 25 kv, was discharged through the low-induction circuit and two Cu loops. The velocity of the axial movement of the plasma was measured, using a double probe moved along the axis of the system. For H pressure of 0.06 mm, the velocity was 1.5×10^6 cm/sec. The exact ion and electron temperatures were not known. The ratio of the electron thermal velocity and the plasma directed velocity at 0.06 mm pressure was about 80. In these conditions, and also for $T_e \gg T_i$, the observed effect may be explained as the instability from impinging plasma currents. Deceleration of the currents in a strong magnetic field produces diamagnetic signals. (M.J.T.)

40716 INVESTIGATION OF PROCESSES IN COAXIAL PLASMA SOURCE. I. M. Zolototrubov, V. A. Kiselev, and Yu. M. Novikov. Zh. Tekhn. Fiz., 34: 998-1004(June 1964). (In Russian)

A coaxial-type plasma source was studied. It was shown that the discharge current between electrodes flows in a narrow layer, about 5 cm thick. This layer moves with a speed of 10^7 cm/sec in the direction of ejection from the gun and leaves behind it the plasma in the crossing electric and magnetic fields. It was demonstrated that the presence of these fields causes a drift of the plasma in a longitudinal direction. (tr-auth)

40717 ENERGY SPECTRA AND STRUCTURE OF PLASMA BUNCHES OF COAXIAL PLASMA SOURCE. A. A. Kalmykova, S. A. Trubchaninov, V. A. Naboka, and L. A. Zlatopol'skii. Zh. Tekhn Fiz., 34: 1005-10(June 1964). (In Russian)

A study was carried out on the energy spectra of ions from plasma clusters produced by a coaxial source. Measurements were performed using a flight mass spectrometer and an electrostatic analyzer. The particle formation and acceleration times in the source and the distributions of particles of different masses and energies according to the length of the cluster were investigated. Various operating modes of the coaxial source are evaluated in detail. Some of the conditions are considered under which high energy particles are created. (tr-auth)

40718 ON THE MEASUREMENT OF THE ENERGY OF PLASMA CLUSTERS BY THERMAL PROBES. Yu. S. Azovskii, I. T. Gyzhovskii, and B. G. Safronov. Zh. Tekhn. Fiz., 34: 1011-12(June 1964). (In Russian)

The effect of heat-detector depth in a plasma and of detector surface screening on the accuracy of measurements by the thermocouple method was studied. The experimental system consisted of an ejector of plasma clusters and a glass vacuum chamber in which the clusters diffused. The energy of the plasma flux was measured by probes placed along the axis of the vacuum system; probes with various length to diameter ratios were used. The measured dependence of energy on detector depth is given for probes with and without screen. (M.J.T.)

40719 EXCITATION OF LONGITUDINAL OSCILLATIONS IN PLASMA WITH NONISOTROPIC ION VELOCITY DISTRIBUTION. V. B. Krasovitskii and K. N. Stepanov. Zh. Tekhn. Fiz., 34: 1013-19(June 1964). (In Russian)

The excitation of longitudinal oscillations of a plasma in a magnetic field with a distribution function of the δ-function type is investigated. The increments of growth of the waves are found for plasma with small ($\Omega_e \ll \omega_e$) and large ($\Omega_e \sim \omega_e$) density, where Ω is Langmuir frequency and ω is gyrofrequency. (tr-auth)

40720 CONDITIONS CONDUCIVE TO CHARGED PLASMA MOTION STABILITY. V. S. Anastasevich.

(Moscow Inst. of Physics and Engineering). Zh. Tekhn. Fiz., 34: 1020-6(June 1964). (In Russian)

The plasma motion, bounded in the direction of the electric field intensity vector, is calculated for the stable motion of a charged particle. The motion in mutually perpendicular homogeneous electric and magnetic fields is considered stable only if the electric field intensity vector is less than the magnetic field induction vector. Conditions for the stability of the movement of a charged plasma are derived for an inhomogeneous electric field, and it is shown that the particles in the plasma may be found for determined conditions in the stable motion in the presence of an external magnetic field. Applications to plasma motion in interplanetary space are discussed. (M.J.T.)

40721 INVESTIGATION OF A CYLINDER STABILIZED BY ARC WALLS WITH INTENSE AXIAL GAS FLOW. I. V. Varlamov. Zh. Tekhn. Fiz., 34: 1027-30(June 1964). (In Russian)

A plasma generator in which the gas is heated by flowing along an arc discharge in a channel of small cross section is described. Conditions for the easy determination of the field intensity in the column are discussed: the temperature distribution along the column must not change and the voltage drops between the column and each of two disk probes must be equal. A block diagram of the apparatus is given. Results of measurements of field intensity, radial energy loss per unit length, and average temperature per column cross section are given for various values of argon flow and arc current. (M.J.T.)

40722 PLASMA OSCILLATIONS EXCITED BY ELECTRON BEAM. I. F. Kharchenko, Ya. B. Fainberg, E. A. Kornilov, and N. S. Pedenko. Zh. Tekhn. Fiz., 34: 1031-6 (June 1964). (In Russian)

The development of instabilities in the interaction of an initially homogeneous (unmodulated) bunch of electrons with a plasma in a magnetic field was studied experimentally. The conditions causing instabilities and the spectra of the excited particles were determined. The experimentally observed instabilities are found in agreement with theoretical predictions of instabilities in interactions of an electron bunch and plasma in a waveguide in a magnetic field. It was found experimentally that, at the expense of the acceleration of the plasma electrons in a high-frequency field during excitation of the instability, supplementary ionization takes place and the plasma density reaches a value several orders higher than the density of the electron cluster. (tr-auth)

40723 LOCALIZATION OF LINEAR HIGH-FREQUENCY CURRENT IN A GAS BY MEANS OF QUADRUPOLE MAGNETIC FIELD. M. D. Raizer, P. S. Strelkov, and A. G. Frank (Lebedev Inst. of Physics, Moscow). Zh. Tekhn. Fiz., 34: 1040-9(June 1964). (In Russian)

A study was made of the configuration of a linear induction discharge at a frequency of ~3 MHz in hydrogen and air at a wide range of gas pressures. It was determined that localization of the current in the gas takes place upon superposition of a quasistatic quadrupole magnetic field on the discharge. With gas pressures higher than 1 mm Hg, localization of the high-frequency current in the gas occurs even in the absence of the quadrupole magnetic field. (tr-auth)

40724 COHERENT OSCILLATIONS IN A HIGH-VOLTAGE PENNING DISCHARGE. M. G. Koganskii, D. L. Kaminskii, and A. N. Klyucharev (Ioffe Inst. of Physics and Tech., Leningrad). Zh. Tekhn. Fiz., 34: 1050-6(June 1964). (In Russian)

Regular oscillations of the discharge current were observed in a high-voltage Penning discharge with a cold cathode in argon at pressures of (0.5 to 4) $\times 10^{-3}$ mm Hg and magnetic fields from 1000 to 3000 Oe. The oscillation frequency (10 to 100 kHz) was proportional to the anode voltage and inversely proportional to the magnetic field intensity. The oscillation amplitude of the discharge current was comparable to the average current magnitude. The possible mechanism of such oscillations is considered. (tr-auth)

40725 LOW-FREQUENCY INHERENT OSCILLATIONS OF PLASMA ELLIPSOID. Yu. A. Berezin. Zh. Tekhn. Fiz., 34: 1124-6(June 1964). (In Russian)

The spectrum of intrinsic frequencies of the inhomogeneous resonance of a plasma cluster forming an ellipsoid by rotation and in a constant magnetic field directed along the ellipsoid axis was studied previously, using a quasistatic approximation and neglecting ion motion approximations valid at intrinsic frequencies sufficiently high in comparison with the ion cyclotron frequency. The dispersion equation and calculation of ion motion are studied in the low-frequency region of the intrinsic-frequency spectrum of the inhomogeneous resonance. The variations of the frequency of intrinsic oscillations of the plasma sphere with the constant magnetic field values are given for various harmonics. The dependence of the resonance frequency for various harmonics on the ratio of the plasma-ellipsoid semiaxes is presented. (M.J.T.)

40726 CONTAINMENT OF CHARGED PARTICLES IN MAGNETIC TRAPS. G. V. Skornyakov (Ioffe Inst. of Physics and Tech., Leningrad). Zh. Tekhn. Fiz., 34: 1126-30(June 1964). (In Russian)

A general qualitative analysis is carried out on charged-particle drift motion in the strong-magnetic-field region near the boundary surface of a trap. It is found that the magnetic traps discussed are absolute traps of charged particles for stable magnetic-field topology and sufficiently high field intensity near the boundary. The charged-particle motion in the traps is dependent on the method of creating the plasma and on the field-intensity distribution. (M.J.T.)

40727 MEASUREMENTS OF ELECTRON DENSITY DISTRIBUTION IN A TOROIDAL DISCHARGE ON THE BETA INSTALLATION. V. G. Averin, E. A. Lobikov, and A. I. Nastyukha. Zh. Tekhn. Fiz., 34: 1131-2(June 1964). (In Russian)

The experimental method used to measure the electron density distribution according to the cross section of a toroidal discharge is described. Results of density variation with the distance from the axis of the discharge are given. (M.J.T.)

40728 THE REVERSE MOTION OF CATHODE SPOT OF AN ARC IN A MAGNETIC FIELD. O. S. Il'enko. Zh. Tekhn. Fiz., 34: 1132-6(June 1964). (In Russian)

The phenomenon of reverse motion of a cathode spot of an electric arc in a magnetic field can be explained by taking into account the significant role of the Hall effect in a plasma column of an arc discharge. The effect of a magnetic field on a charged particle moving in a cold plasma with an electric field is analyzed. The qualitative characteristics of the reverse-motion phenomenon coincide with results of numerous previous experiments, thus decisively indicating the important role of the Hall effect in the phenomenon. (M.J.T.)

40729 THE KINETIC THEORY OF SURFACE WAVES IN A PLASMA. M. F. Gorbatenko and V. I. Kurilko. Zh. Tekhn. Fiz., 34: 1136-8(June 1964). (In Russian)

The effect of thermal diffusion of plasma electrons on

the propagation of a slow surface wave along a plasma-vacuum boundary is studied. The dispersion relation of this wave is considered for zero electron temperature and for weak thermal diffusion. The plasma impedance, wave dispersion relation, and wave damping are derived. (M.J.T.)

40730 PLASMA SPECTROSCOPY. Hans R. Griem. New York, McGraw-Hill Book Company, 1964. 589p. $18.50.

A review is presented of basic theory, experimental techniques and results, and applications of plasma spectroscopy to the measurement of atomic and plasma properties. Specific topics studied include: classical and quantum theory of radiation; line-oscillator-strength and line-broadening calculations; calculations of continua; equilibrium relations; radiation from extended sources; radiative energy losses; plasma light sources; optical instruments and radiation detectors; radiation standards; and measurements of density, temperature, and atomic parameters. (T.F.H.)

40731 PLASMA KINETIC THEORY. D. C. Montgomery and D. A. Tidman. McGraw-Hill Advanced Physics Monograph Series. New York, McGraw-Hill Book Co., 1964. 302p. $11.50.

An attempt is made to describe the present state of the theory of plasma in those situations where the particles can be considered to interact according to the laws of classical mechanics. The aims and limitations of classical kinetic theory, the BBGKY theory, and selected applications are discussed. (C.E.S.)

40732 THE INTERACTION OF AN ANTENNA WITH A HOT PLASMA AND THE THEORY OF RESONANCE PROBES. J. A. Fejer (Southwest Center for Advanced Studies, Dallas). 19p. (CONF-630-3)

From Conference on Non-Linear Processes in the Ionosphere, Boulder, Colo., Dec. 1963.

The impedance and the radiation field of a short antenna, which consists of two spherical conductors excited through very thin wires in phase opposition, are calculated. In the calculations the pressure tensor is replaced by a scalar pressure. A discontinuous model of the ion sheath is used. The losses due to the radiation of electromagnetic and electron-acoustic waves are calculated and are expressed in terms of equivalent series resistances. The operation of resonance probes is discussed. It is shown that their resonant frequency is well below the electron plasma frequency if the probe radius is much larger than the Debye length. The significance of this result to both past and future ionospheric rocket probe experiments is pointed out. The limitations of the present treatment are discussed. (auth)

40733 ARC PLASMA GENERATOR. John H. McGinn (to General Electric Co.). U. S. Patent 3,146,371. Aug. 25, 1964. Filed July 20, 1961.

An arc plasma generator is designed for producing a very high enthalpy plasma in which the contamination by the electrodes is minimized and the temperature, composition, and velocity profile is uniform. The generator comprises a pair of vortex chambers, a plenum chamber between the chambers, and an arc column between a pair of electrodes extending through the vortex chambers. The operation of the generator is described in detail. (D.L.C.)

Shielding

40734 (AD-600684) A SEMIEMPIRICAL FORMULA FOR DIFFERENTIAL DOSE ALBEDO FOR NEUTRONS ON CONCRETE. Type C. Y. T. Song (Naval Civil Engineering Lab., Port Hueneme, Calif.). Mar. 27, 1964. 21p. (TN-589)

A semiempirical formula is developed, which yields values for the differential dose albedo of neutrons on concrete. Neutrons of incident energies 0.1, 0.25, 0.5, 1, 2, 3, 5, and 14 Mev are considered. Results show that a one-parameter formula gives satisfactory agreement with Monte Carlo calculations. A simple analytic form also gives satisfactory results except in low energy regions. The principal assumption involved in the theoretical analysis is that the actual reflection process can be approximated by a simplified neutron scattering model; namely that the scattering of neutrons in concrete is isotropic in the laboratory system. (auth)

40735 (EUR-1643.e(p.87-108)) RESEARCH ON RADIATION SHIELDING. U. Canali, B. Chinaglia, C. Manduchi, W. Matthes, R. Nicks, N. Papmehl, H. Penkuhn, and G. Perlini (European Atomic Energy Community. Joint Nuclear Research Center, Ispra, Italy).

An analytical method of treating energy-dependent neutron transport problems is discussed. Solutions are found by expanding the angular neutron flux in eigenfunctions of the energy transfer operator. The restrictive assumptions are plane geometry, purely elastic scattering, and constant cross sections. Integral representation of the solution instead of a series expansion is given. A numerical method for the integration of the Boltzmann transport equation for gammas is described. Starting from the two coupled integral equations for the generalized source density and the angular flux at source energy, these quantities are calculated successively for increasing wavelength of the gammas (decreasing energy). The results of a monoenergetic collimated beam incident on a slab of Fe and Pb are given. Build-up factors are compared with those given by Goldstein. Experimental work was carried out in the field of fast-neutron propagation in water. Monoenergetic neutrons were produced by a 5.5-Mev Van de Graaff accelerator. Water and oxygen removal cross sections as a function of energy are given. Neutron penetration in ducts surrounded by water was investigated. The neutron source was a natural-uranium convertor plate. Fast and thermal neutron flux profiles on the axis of the cylindrical ducts were measured with threshold and resonance detectors. Asymptotic slopes of fast-neutron profiles are given. (auth)

40736 (NAA-SR-9364) EXPERIMENTAL STUDIES OF NEUTRON ATTENUATION IN NATURAL LITHIUM HYDRIDE SHIELDS. S. G. Wogulis and K. L. Rooney (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Feb. 12, 1964. Contract AT-11-1-GEN-8. 43p.

Results of a program to measure the attenuation of fission neutrons in lithium hydride at the SNAP Shield Test Facility are presented with the methods used. Experimental and analytical corrections to the data are given, to allow reduction to the infinite medium case. (auth)

40737 (TO-B-64-49) THE DOSE RESULTING FROM 1.25-Mev PLANE SOURCE BEHIND VARIOUS ARRANGEMENTS OF IRON BARRIERS. Final Report. Dominic J. Raso and Stanley Woolf (Technical Operations Research, Burlington). June 1964. Contract OCD-OS-62-219. 47p.

Calculations were performed by the Monte Carlo method to determine the dose at various positions behind parallel barriers (circular or rectangular). In some cases, the parallel barriers were separated. Also, calculatoins were made for a blockhouse geometry. The results were obtained for a 1.25 Mev plane monodirectional source (angles

of incidence given by cos Θ_0 = 0.0, 0.25, 0.50, 0.75, 1.0, and isotropic) incident on 20.5, 41.0, and 61.5 psi of Fe. Comparisons were made with roof reduction factors obtained by Spencer and with experiments performed at Technical Operations Research. (auth)

40738 INVESTIGATION OF SPACE-ENERGY DISTRIBUTION OF BP-5 REACTOR NEUTRONS IN IRON ORE MEDIUM. V. K. Daruga, I. I. Lazutkin, A. N. Nikolaev, D. M. Pinkhasik, V. K. Sakharov, B. I. Sinitsyn, and S. G. Tsypin. At. Energ. (USSR), 17: 63-5(July 1964). (In Russian)

The use of a reactor shield made of iron ore with a high content of iron and light elements, especially oxygen, was studied. The composition of the material is given; the final product has good thermal conduction and heat resistance. The effect of a small amount (about 0.3% by weight) of H on the performance of the shielding material was also investigated. Detectors used were Al and S threshold detectors, a fission chamber, a proton-recoil counter, and Cu and In resonance indicators. Results of neutron spatial-energy distributions were fitted to a neutron attenuation function for an infinite plane monodirectional source; results are graphed for shielding materials with and without H. Measured relaxation lengths and attenuation functions are compared with previous results for Fe and Fe–C media. (M.J.T.)

40739 ATTENUATION OF FISSION NEUTRON FLUXES IN IRON–AQUEOUS MIXTURES. V. P. Mashkovich, A. N. Nikolaev, B. I. Sinitsyn, and S. G. Tsypin. At. Energ. (USSR), 17: 65-6(July 1964). (In Russian)

A study was made of the attenuation of fast, thermal, and intermediate neutrons in Fe–water mixtures with Fe concentrations more than 75% by volume. Measurements were performed using the BR-5 reactor. Detectors used were ^{27}Al, ^{32}S, and ^{63}Cu. The dependence of the relaxation length of fast and of intermediate neutrons on the Fe concentration is presented. (M.J.T.)

40740 COMBINATION OF MATERIALS WITH BEST SHIELDING PROPERTIES. G. Thuro (Institut für Reaktorphysik der GKSS, Nuremburg). Atomkernenergie, 9: 263-70(July-Aug. 1964). (In German)

By means of known properties of materials and general simplifying considerations a survey of combinations of materials with best shielding properties was made. A plane parallel beam of fission neutrons and γ rays hitting a plane shield was assumed. For each of the four radiation groups (fast, epithermal, and thermal neutrons and γ rays) the materials with the shortest relaxation lengths are listed. From this the combinations of materials with lowest radiation transmission were found. For the various combinations of materials the optimum volume-ratio of metal to the hydrogen-containing component is given. (auth)

40741 MONTE CARLO CALCULATIONS OF GAMMA-RAY BACKSCATTERING BY AIR. F. W. Krueger (VEB Atomkraftwerk, Berlin). Kernenergie, 7: 406-11(June-July 1964). (In German)

To clarify the conditions prevailing at the earth-air boundary the backscattering of gamma quanta through an air hemisphere with totally absorbing border was investigated by means of the Monte Carlo method employing a ZRA 1 type computer. Determinations were made for distances between 15 and 500 meters from the source, quantum energies emitted by the source in the 0.2 to 1.5 Mev range, and various radiation angles. The results obtained by means of the calculations described were consolidated into an empirical equation, which provided results of an adequate degree of accuracy. (auth)

40742 LEAD FOR RADIATION SHIELDING. NUMBER FOUR. LOCAL MOVABLE SHIELDS. London, Lead Development Association, 1964. 15p.

The use of lead bricks for local movable shields is discussed, and several hot cells are illustrated. (C.E.S.)

40743 LEAD FOR RADIATION SHIELDING. NUMBER THREE. DESIGN AND ERECTION OF SPACE SHIELDING. London, Lead Development Association, 1964. 20p.

The use of lead for room or structural shielding, which is commonly called space shielding, is discussed. The available forms and application techniques, including sheet lead and lead laminates are considered. Shielding design for various types of structures and doors and other discontinuities is also discussed. (C.E.S.)

40744 A LAST-COLLISION APPROACH TO CALCULATING THE ANGULAR DISTRIBUTION OF FAST NEUTRONS PENETRATING A SHIELD. R. L. French (Radiation Research Associates, Inc., Fort Worth, Tex.). 23p. (CONF-446-18).

From American Nuclear Society 10th Annual Meeting, Philadelphia, June 1964.

To perform fast-neutron penetration calculations, a method is described that offers some of the advantages of Monte Carlo and other highly sophisticated methods, yet retains some of the features of the line-of-sight kernel methods. The method includes the use of effective flux removal cross sections to predict a distribution of "last-collision" centers in a shield, and uses statistical estimation to obtain the flux at the receiver from each last collision. The chief advantage of this method is that it provides an approximate angular distribution of the neutron flux at the receiver and includes the effects of boundaries, but is much less costly to apply than Monte Carlo. Detailed formulations for slab and for cylindrical geometries are given, along with initial results of an evaluation based on comparisons with Monte Carlo and with measured data for lithium hydride shields. (auth)

40745 A GENERAL GEOMETRY SHIELDING CODE FOR SPACE PROTONS. Richard Madey, David Levine, Frank E. Schwamb, and Florian M. Sisavic. 4p. (CONF-446-31)

From American Nuclear Society 10th Annual Meeting, Philadelphia, June 1964.

An IBM-7094 machine program is generated to calculate the radiation dose rates from primary protons at arbitrary points within space vehicle structures. The program is designed for use with arbitrary vehicle geometries. Typical accuracies obtainable with the program are on the order of 1%. Results are shown for several geometries, assuming typical solar-flare proton spectra. (T.F.H.)

40746 RADIATION SHIELDING COMPOSITION. Harold L. Dunegan (to U. S. Atomic Energy Commission). Canadian Patent 693,200. Aug. 25, 1964. Priority date Dec. 21, 1960, United States.

A gamma radiation shielding material is compounded consisting of 55–70% by weight of polyurethane, polyethylene and epoxy, 15–40% by weight of metal powder selected from the group consisting of lead and tungsten, 1–15% by weight of resin plasticizer selected from the group consisting of trichloroethyl phosphate, tricresyl phosphate, castor oil, dibutyl phthalate and dioctyl phthalate, 1–5% by weight of polymerization catalyst selected from the group consisting of benzoyl peroxide, lauroyl peroxide, and orthochloro-aniline. Sufficient air is included so that the density is 1.3–1.5 g/cc. The material is prepared by adding the powdered metal to a mixture of polyurethane resin, plasticizer, and catalyst with stirring to incorporate air, and curing at an elevated temperature. (F.S.A.)

REACTOR TECHNOLOGY

General

Refer also to abstract 39512.

40747 (APED-4564) DETERMINATION OF REACTOR STEAM CARRYUNDER BY A DOWNCOMER HEAT BALANCE. G. W. Fitzsimmons, Jr. (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). Mar. 1964. 42p. (R64APE-1)

A heat balance on the reactor downcomer was used to derive an equation for calculating the carryunder from the axial steam separators, and an analysis was made of the effect of measurement errors on this calculation. The analysis was performed using mathematical probability and considered only random errors. Two measurement systems were considered. One system includes the measurements of feedwater flow rate, total recirculation flow rate, feedwater temperature, and combined recirculation flow temperature and steam pressure on the discharge side of the axial separators. A second system replaces the temperature measurements by the measurement of relative temperatures between the saturated water leaving the separators and the feedwater, and between the saturated water and the combined recirculating flow. The analytical expressions were used to define the instrumentation requirements for measuring carryunder in the Kernkraftwerk–RWE–Bayernwerk (KRB) reactor, using the approximate design values for flow rates and temperatures. (auth)

40748 (BNL-8281) DESIGN AND ECONOMIC STUDY OF A GAS-PHASE CHEMONUCLEAR OZONE PROCESS. M. Beller, D. Goellner, and M. Steinberg (Brookhaven National Lab., Upton, N. Y.). [nd]. Contract AT-30-2-GEN-16. 4p. (CONF-654-1).

For Presentation at American Nuclear Society Meeting, San Francisco, Nov.-Dec. 1964.

A reactor is described which uses fission fragment energy to produce O_3. Its design characteristics are tabulated. The core comprises an assembly of honeycombs of Pd foils containing 20 wt % highly enriched U, and the neutrons are moderated entirely by the graphite reflector around the core. Oxygen is used as both reactor coolant and chemical reactant; heat is removed by a Freon-12 refrigeration system, and O_3 is sorbed on Freon-22-cooled silica gel. The cost of producing O_3 is estimated to be 11¢/lb for a G-value of 15. (D.L.C.)

40749 (CONF-337-6) SOME PROBLEMS ASSOCIATED WITH THE ACCIDENTAL RELEASE OF FISSION PRODUCTS FROM A NUCLEAR REACTOR. F. T. Binford (Oak Ridge National Lab., Tenn.). [1963]. Contract W-7405-eng-26. 16p.

From International Conference on Radioactive Pollution of Gaseous Media, Saclay, France, Nov. 1963.

The approximation of a least upper bound to the consequences of fission-product release from a reactor due to a credible accident is discussed. (R.E.U.)

40750 (CONF-446-36) CALCULATION OF NEUTRON ABSORPTION RATIOS IN D_2O MODERATED MIXED LATTICES. J. E. Suich (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). June 1964. Contract AT(07-2)-1. 39p.

From American Nuclear Society 10th Annual Meeting, Philadelphia, June 1964.

A technique is described for combining one-dimensional, thermal multigroup cell calculations (the THERMOS code) with source sink, heterogeneous reactor lattice calculations (the HERESY code) to synthesize the full two-dimensional, multigroup reactor flux in lattices containing more than one type of fuel element. The synthesis technique is a generalization of the Wigner-Seitz approximation commonly employed in uniform lattice cell calculations. Whereas for a uniform lattice the location of zero current contours and hence of the cell boundaries is presumed known in a mixed lattice, the location of zero current contours must be determined. This can be done by analysis of the ratios of fuel element absorption rates, if the assumption is made that the average thermal group zero current contour applies at all thermal energy. An analysis of the method for combining the HERESY-THERMOS calculations is presented. (J.R.D.)

40751 (DPST-64-83-7) USAEC-AECL COOPERATIVE PROGRAM MONTHLY PROGRESS REPORT, JULY 1964. H. S. Hilborn, comp. (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). Aug. 24, 1964. Contract AT(07-2)-1. 19p.

The testing of CANDU Reactor fuel rod bundles in the HWCTR is discussed. The effect of rod spacing on heat transfer burnout of fuel bundles is being evaluated. Thin-walled Zircaloy tubing with widely different textures appeared to be embrittled with less than 60 ppm hydrogen in the form of hydride platelets perpendicular to the deforming stress. The highest ductility was exhibited by tubing with a balanced texture parallel to the deforming stress. Poor feedwater quality in July again limited gas flow in the GS heavy water plant test unit to 30% greater than that demonstrated at low 225-psig-pressure. It still seems unlikely that the gas flow with sieve trays at 280 psig would be 30% greater than that achieved in the GS plant with bubble cap trays before GS plant pressure was decreased. (N.W.R.)

40752 (HW-81302(Rev.1)) ZODIAC USER'S MANUAL—03-30-64. D. D. Matsumoto and G. J. Busselman (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Mar. 1964. Contract AT(45-1)-1350. 31p.

ZODIAC is a multigroup IBM 7090 code for the burnup analysis of reactor fuel. In this code, microscopic cross sections are recalculated at each burnup time step, burnup is treated on a multiregion basis, and the spectrum of the reactor and the isotopes to be burned are completely flexible. Instructions cover limitations, data flow, restart, operation, and input. (D.L.C.)

40753 (IDO-16977(p.1-20)) REACTOR PHYSICS AND ENGINEERING. (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho).

Reactor fuel material consisting of U_3Si particles embedded in an aluminum matrix have been examined with an electron microprobe to determine reaction between fuel particles and matrix. Partial reaction was observed with no observable tendency for the uranium or silicon to diffuse outward into the matrix. An evaluation of techniques used in ARMF reactivity measurements included: a study of temperature control of canal water; studies of the effect of rod and sample positions on accuracy of the measurements; and an analysis of reactivity measurements where self-shielding is involved. Resonance absorption

integrals are reported for natural dysprosium and hafnium and for their major isotopes. Investigations of possible ^{135}Xe oscillations in the ATR indicate stability against any reasonable perturbation. Calculations with the AIM-6 diffusion code indicate that reactivity measurements in the ARMF cadmium tube need to be corrected for non-1/E flux and for an adjoint flux that varies with energy. Fuel loadings are calculated for MTR operations during 1963. (auth)

40754 (NAA-SR-Memo-9800) PROGRESS TO DATE TOWARD THE DEVELOPMENT OF A GENERALIZED DIGITAL SIMULATOR FOR REACTOR DYNAMICS: AIREK 3A AND 3B. R. A. Blaine and R. F. Berland (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Apr. 1964. Contract [AT(11-1)-Gen-8]. 81p.

Modifications were made to AIREK to provide additional generality for dynamic simulation of a reactor using a numerical method developed by E. R. Cohen. AIREK 3A includes equations for flow decay from full power and after a scram, scrams based on delayed instrumentation signals, after glow heating, control rod fall under gravity, and generalized printed and graphical output. Any feedbacks can be grouped on a CRT frame and/or printed. Provision is made for heat transfer by conduction and convection with flow dependent film coefficient. AIREK 3B is a modification of AIREK 3A made to provide crude models for fuel melting, nucleate and bulk boiling, vaporization of coolant, and burnout. (auth)

40755 (NAA-SR-Memo-9837) REACTOR KINETICS AND REACTOR SAFETY STUDIES. R. A. Blaine (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Apr. 24, 1964. Contract [AT(11-1)-Gen-8]. 32p.

The goals and accomplishments in reactor kinetics and reactor safety studies of the Atomics International Reactor Safety Program are reviewed. Present directions and future requirements are presented. (auth)

40756 (NP-14259) REACTOR SAFETY AND HAZARDS EVALUATION. (Public Health Service, Washington, D. C. and Robert A. Taft Sanitary Engineering Center, Cincinnati). Mar. 1964. 223p.

The basic theory of nuclear reactors and their control, reactor safety and hazards evaluation, site selection, and emergency planning are presented in a manual for a training course for public health personnel. (R.E.U.)

40757 (ORNL-3657) AN INVESTIGATION OF THE INFLUENCE OF THE HOLDUP EFFECT OF DOUBLE CONTAINMENT ON REACTOR HAZARDS. T. D. Anderson (Oak Ridge National Lab., Tenn.). Sept. 1964. Contract W-7405-eng-26. 76p.

Thesis submitted to Univ. of Tennessee, Knoxville.

A dual reactor-containment system would be expected to effect a time-delay in the release of airborne materials to the environment. An investigation was made of the influence of this time-delay on reactor hazards. The containment model used in the investigation was made up of three series-connected enclosures consisting of the reactor core and two concentric containment vessels. General equations were obtained for the time-dependent rate of release of airborne materials from a double containment system. A graphical solution for the rate of release was given for the practical case of step release of fission products from the reactor core. Using the release-rate equations that were developed, an investigation was made of the effect of double-containment holdup on the dose arising from airborne radioactive materials. The effect on dose was expressed as the ratio of the double-container dose, D(t), to the single-container dose, $D_1(t)$. It was found that this dose ratio could, for a given radioisotope, be described by simple expressions for two limiting periods of time after an accident. The short-term dose ratio is independent of the decay characteristics of the isotope causing the dose and can be expressed as

$$\frac{D(t)}{D_1(t)} = \frac{m(t-t_0)}{2}$$

where m is the fraction of the material in the second container that is released in unit time and t_0 is the time at which the material is released from the core to the first container. The long-term dose ratio is given by

$$\left[\frac{D(t)}{D_1(t)}\right]_{t=\infty} = \frac{1}{1+\lambda/m}$$

where λ is the decay constant of the isotope causing the dose. The use of filters and charcoal units in conjunction with double containment would be expected to result in a very great reduction in the release of particulate fission products and radioiodine. Under such circumstances the noble gases could become the controlling environmental hazard. Based on this premise, an analysis was made for a typical power reactor of the influence of the holdup effect of double containment on the allowable reactor power for a given reactor site. The results were obtained in the form of the power ratio, P_2/P_1, as a function of m where P_2 is the allowable power with double containment, P_1 is the allowable power with single containment, and m is as defined above. The primary containment vessel of the N.S. Savannah reactor is enclosed by the reactor compartment. This compartment, which is exhausted by a blower, forms a second reactor container. The effects of material holdup in the compartment on the hazards arising from the accidental release of the radioactive noble gases and radioiodine were considered. The graphical results were obtained in two different forms. The dose ratios (defined above) were obtained as a function of time after the accident, and the time-delay because of holdup was found. The results indicated that the holdup effect of the reactor compartment would have a very significant influence on the consequences of a reactor accident especially for low values of the compartment blower exhaust rate. To take credit in reactor hazards evaluations for the holdup effect of double containment, the effect should be demonstrable. The properties of a double-containment system with a blower-exhausted second container make possible a rather unique method of measuring the leak characteristics of the total containment system. The method involves the introduction of a quantity of tracer gas to the first container and the measurement of the time-dependent rate of release of this tracer gas from the second container. Using this method it is therefore possible to obtain the time-response of the whole containment system to a step input of gaseous material to the first container. The salient features of the proposed containment test method were investigated for the N.S. Savannah containment system using helium as the tracer gas. (auth)

40758 (WAPD-T-1663) NEW TOOLS FOR REACTOR EXCURSION ANALYSIS. J. A. Redfield, K. J. Chock, and S. G. Margolis (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Jan. 1964. Contract AT-11-1-GEN-14. 17p. (CONF-446-12)

From American Nuclear Society 10th Annual Meeting, Philadelphia, June 1964.

A reactor excursion model is proposed which is based on the fundamental conservation laws of energy, mass, momentum, and neutrons applied to a single fuel element-flow passage system. The reactor kinetics equations are solved for continuous reactivity feedback from moderator density change, moderator temperature change, fuel temperature change, and fuel plate expansion. All input parameters can be evaluated without recourse to empirical reactivity or energy coefficients, thus allowing prediction of the performance of proposed systems. This model was reduced to practice initially on an analog computer, and subsequently a more detailed version was programmed successfully for the digital computer. (auth)

40759 ECONOMIC ANALYSIS OF PLUTONIUM FUEL USE. E. A. Eschbach (General Electric Co., Richland, Wash.). Business At. Rept., Suppl. No. 64-3, 4p.(May 1964).

The overall cost of utilizing Pu cannot be determined directly because Pu is not found in nature but is a by-product without a specific production cost. Thus, development of two general types of data is required: the values that Pu may have as a nuclear fuel and the costs at which Pu can be recovered, as well as the likely prices at which it will be offered on the market. The Pu values reported $10 to $12/gram fissile based upon direct replacement of the slightly-enriched uranium oxide fuel core with Pu and U oxides. It was concluded that Pu enrichment can be economically used in reactors designed for slightly-enriched uranium. (P.C.H.)

40760 TESTS SEEK SAFETY FACTS, AID SITING. Clifford K. Beck (Atomic Energy Commission, Washington, D. C.). Elec. World, 161: No. 20, 109-11(May 18, 1964).

The AEC research and test program on reactor safety is briefly discussed, with particular attention to studies of factors in reactor siting. (D.C.W.)

40761 MEASUREMENTS OF CONVERSION RATIO, RESONANCE ESCAPE, AND FAST FISSION AS STUDENT EXPERIMENTS. D. A. Daavettila (International Inst. of Nuclear Science and Engineering, Argonne, Ill.). Nucl. Sci. Eng., 20: 142-50(Oct. 1964).

The sequence of three reactor-physics measurements as pedagogical experiments is discussed in regard to parameter interpretation, theory of measurement, and technique of measurement. The experimental apparatus and techniques were in part chosen for their teaching value; perhaps particularly significant is the technique for correcting the ^{239}Np activity for the fission activity contribution. The time and equipment requirements are presented in detail, and some results are briefly summarized. (auth)

40762 EXPERIENCE IN OPERATION OF A REACTOR SAFETY DEPARTMENT. B. Filipiak (Inst. of Nuclear Research, Warsaw). Symp. Tech. Zagadnien Ochrony Promieniowaniem, Warsaw, 624-35(1962). (In Polish)

The four years of experience gained in the operation of the VVRS Reactor are summarized with respect to reactor safety. The following problems are described: radiation dose, evaluation of some sources of danger in the reactor operation, radiation protection devices used, movement of radiation sources, and possible incidents at the reactor. (tr-auth)

40763 EVALUATION OF THE STATIONARY SYSTEM FOR DOSIMETRIC CONTROL OF THE WWRS REACTOR. W. Zak and B. Filipiak (Inst. of Nuclear Research, Warsaw). Symp. Tech. Zagadnien Ochrony Promieniowaniem, Warsaw, 636-45(1962). (In Polish)

In relation to the existing stationary radiation control system of the VVRS Reactor, the suitability of installation of measurement point, measurement difficulties, and some aspects of the apparatus solutions used are discussed. The following control systems were described: control system for dose output of γ emitters, control system for the concentration of radioactive gases and dusts, control system for neutron emitters, contamination control systems, and blockade systems. (tr-auth)

40764 RADIATION PROTECTION PROBLEMS IN SELECTION OF REACTOR MATERIALS. F. W. Kroeger (VEB Entwicklung und Projektierung Kerntechnischer Anlagen, Berlin). Symp. Tech. Zagadnien Ochrony Promieniowaniem, Warsaw, 646-61(1962). (In German)

Fission products appear in the coolant or moderator from recoil and corrosion when a uranium-containing material is used in the cladding of reactor fuel elements. The effect that these fission products have on the radiation safety in a nuclear power plant was investigated. The power plant uses a pressurized water reactor whose fuel elements are clad with uranium-containing zirconium. When zirconium containing more than 30 ppm natural uranium is used, the personnel can be injured during repairs to the coolant circuits because of the fission products produced by the radiation. (tr-auth)

Auxiliaries and Components

Refer also to abstract 39814.

40765 (IOI-265) PERFORMANCE OF THE NRU CONTROL RODS. R. E. Manson (Atomic Energy of Canada Ltd., Chalk River, Ont.). July 1964. 28p. (AECL-2036)

The performance of the NRU Control Rods from the start of operation in 1957 until November 1963, is reviewed. The operating records are summarized in the form of charts showing control rod insertions and removals from the various reactor sequence positions. Operating problems and control rod faults are discussed. A development program since 1957 led to several changes in the design of control rod components and resulted in a considerable improvement in the reliability and performance of the rods. All the modifications were completed except that a few rods still have old style magnets. These are being replaced by new stainless steel magnets as the rods become available for maintenance. No further modifications in design are indicated at the present time. Detailed operating records will continue to be maintained to assess the performance of the control rods. (auth)

40766 (ORNL-3685) A REACTIVITY COMPUTER FOR USE WITH NUCLEAR REACTOR CONTROL SYSTEMS. L. C. Oakes (Oak Ridge National Lab., Tenn.). Sept. 1964. Contract W-7405-eng-26. 50p.

Thesis submitted to Univ. of Tennessee, Knoxville.

An electromechanical analog computer for computing relatively slow changes in reactivity in a high-power-density thermal reactor is described. Analytic expressions in the form of differential equations describing fission-product poisoning and fuel depletion are given. The analog computer was designed to provide solutions to these differential equations. Design criteria are given. A functional block diagram and considerable design details of the computer are also given. Results of several tests indicate that the percentage of error in computed reactivity is no greater than 3.2. This maximum error occurred in an overall operating time of 8.85 hours. (auth)

40767 (SWRI-1228-35) EVALUATION OF THE SERVICEABILITY OF THE ELK RIVER REACTOR PRESSURE VESSEL. Progress Report No. 7, June 1–July 31, 1964. C. E. Lautzenheiser, José McDonald, Jr., Allen R. Whiting, and Paul D. Watson (Southwest Research Inst., San Antonio). Aug. 21, 1964. Contract AT(11-1)-1228. 22p.

The serviceability of the pressure vessel for the Elk River Power Reactor is analyzed by determining the effects of fabrication history, dissimilar weld metallurgy and geometry, and irradiation on the nil-ductility transition temperature and fatigue properties of the completed vessel. An additional phase of this investigation is directed toward the development of remote nondestructive testing equipment and techniques for the detection and monitoring of gross defects in critical areas of the vessel. (N.W.R.)

40768 SHIELDING OF NUCLEAR REACTORS BY CONCRETE. L. N. Zaitsev, B. S. Sychev, and A. M. Tugolukov. Beton i Zhelezobeton, 10: No. 1, 8-12(1964). (In Russian)

The absorption of gamma radiation and neutrons in concrete shielding was investigated. The results indicate that the water content should be at least 3.5 wt%. Normal concrete with a density of 2300 kg/m^3 provides optimum protection, considering both economic and technological aspects. (D.C.W.)

40769 ANALYSIS OF A NUCLEAR REACTOR SUPPORT STRUCTURE. A. H. Marchertas (Argonne National Lab., Ill.) and G. M. Smith. J. Spacecraft Rockets, 1: 247-52(May-June 1964).

A general solution is presented for the deformation of a circular grid support structure, which consists of two parallel perforated plates positioned one above the other and interconnected by a large number of tubes. The solution is based on a modified shape function for a circular plate, which may be subjected to any degree of edge restraint, ranging from fixed to simple supports. The Rayleigh-Ritz method is used in conjunction with the Lagrangian multiplier associated with the degree of edge restraint. The complexity introduced by the holes in the two plates is circumvented by the use of two equivalent solid plates. The solution is given in terms of a set of simultaneous algebraic equations with a general expression for the coefficients. (auth)

40770 THE LOOP KAHL FOR NUCLEAR SUPERHEAT EXPERIMENTS. R. Kuehnel (Allgemeine Elektricitats-Gesellschaft, Frankfurt am Main). Kerntechnik, 6: 303-11 (July-Aug. 1964). (In German)

The loop installed at the Kahl power plant for testing superheat fuel elements is described, including the connection between the loop and the power station, the instrumentation and control units, the additional fuel handling equipment, and the design and core location of the initial superheat elements. (D.C.W.)

40771 SHORT REVIEW OF LIQUID METALS TECHNOLOGY FOR REACTORS. J. H. Freund (Universität, Berlin). Kerntechnik, 6: 350-5(July-Aug. 1964). (In German)

The technology of liquid metal coolants is briefly reviewed with consideration of materials, thermophysical properties, and heat transfer. (D.C.W.)

40772 DEVELOPMENT OF IMPROVED HEAVY PLATE STEELS FOR NUCLEAR REACTOR PRESSURE VESSELS. John A. Gulya (Lukens Steel Co., Coatesville, Penna.). 24p. (CONF-446-13)

From American Nuclear Society 10th Annual Meeting, Philadelphia, June 1964.

An evaluation of the applicability of various steels as pressure vessels for future nuclear reactors is carried out, under the assumption that the steel thickness must be about 11 to 15". The characteristics of 15" A 302 B steel plate are studied. Improvements over these characteristics are sought by two alternatives: changing the fabrication parameters of the A 302 B steel; or going over to the use of Ni–Cr–Mo steels, Cr–Mo steels, and 9% Ni steel. The characteristics of thick plates of all these improved steels are studied. (T.F.H.)

40773 RADIOACTIVITY OF NUCLEAR REACTOR COOLING FLUIDS. John C. Ward (Univ. of Arkansas, Fayetteville). 6p. (CONF-179-12)

From American Chemical Society Radionuclidic Exchange on Soils, Minerals, and Resins, Philadelphia, Apr. 1964.

Mechanisms whereby radioactive isotopes are introduced into the coolant of a nuclear reactor are analyzed. Results are analyzed in detail for the coolant of the ORNL Research Reactor. (T.F.H.)

40774 NUCLEAR REACTOR COOLANTS. Edward C. Kooyman (to Shell Oil Co.). Canadian Patent 603,038. Aug. 25, 1964. Priority date Sept. 5, 1958, Netherlands.

This new coolant consists of 1, 3, 5-triphenylbenzene and a material selected from a group comprising a terphenyl, mixture of isomeric terphenyls, byphenyl, monoisopropyl biphenyl, and alkyl derivatives of 1,3,5-triphenyl benzene. Each alkyl group contains no more than four carbon atoms. One coolant mixture is an aromatic petroleum extract being 80 mole % 1,3,5-triphenylbenzene and 20 mole % para-terphenyl. (F.S.A.)

40775 NUCLEAR REACTOR MODERATOR STRUCTURE. Roderick Taylor (to Nuclear Power Plant Co., Ltd.). Canadian Patent 693,079. Aug. 25, 1964. Priority date Sept. 29, 1959, Great Britain.

A solid moderator core structure is designed for a nuclear reactor consisting of blocks of neutron moderating material and a constraining framework around the periphery which applies forces to restrict the lateral movement of the blocks. The arrangement is such that lateral forces are changed in direction so as to cause movement of the blocks relative to one another but in vertical direction at the same time maintaining a fixed lattice pitch between corresponding vertical axes of the blocks. The individual units are of two types: dynamic and static, which alternate with one another in columns. Sliding contact occurs between the blocks in a dynamic and static column. (F.S.A.)

40776 NUCLEAR REACTOR CONTROL DEVICE. Robert W. Deutsch and Frank Devilacqua (to General Nuclear Engineering Corp.). Canadian Patent 694,322. Sept. 15, 1964. Priority date Dec. 2, 1960, United States.

This device, for controlling reactivity in the active portion of the reactor consists of longitudinal stationary members and members rotatable about an axis parallel with the longitudinal axis. The stationary and movable arms contain a fuel and a poison disposed so that when the movable arms are in one extreme position, the fuel is sandwiched between poison and in the other position the poison is sandwiched between fuel. (F.S.A.)

40777 APPARATUS FOR DETECTING FAULTS IN THE CASINGS OF FUEL RODS EMPLOYED IN A NUCLEAR REACTOR. René Donguy and Jean Mégy (to Commissariat à l'Énergie Atomique). U. S. Patent 3,146,171. Aug. 25, 1964. Priority date Oct. 3, 1959, France.

An apparatus is designed for detecting faults in the channels of a reactor. In this apparatus, the sampling pipes associated with the channels are arranged in a square matrix of rows and columns, and each sampling pipe is connected to a row collector and a column collector. The various row and column collectors communicate with single detectors through selector means. Thus, a channel with a fault may be identified without having to carry out individual channel monitorings. Means are provided for equalizing the pressures in the apparatus. (D.L.C.)

40778 MODERATOR FOR NUCLEAR REACTORS. Stefan George Bauer (to Rolls-Royce Ltd.). U. S. Patent 3,146,172. Aug. 25, 1964. Priority date June 19, 1959, Great Britain.

A reactor moderator is described which comprises light water and a metal, either lead or magnesium. This moderator has the advantage that by varying the ratio of light water to metal, the slowing-down length of the moderator mass can be adjusted to the desired value. Also, when lead is used, some shielding of the gamma rays is obtained, and the biological shield of the reactor may be reduced. Control of the reactor may be obtained simply by providing means for varying the light water-metal ratio, e.g., filling or emptying passages with light water. Several embodiments of a reactor lattice using the above moderator are described. (D.L.C.)

Criticality Studies

40779 (ANL-6847) DYNAMIC ANALYSIS OF COOLANT CIRCULATION IN BOILING WATER NUCLEAR REACTORS. Chathilingath K. Sanathanan (Argonne National Lab., Ill.). Apr. 1964. Contract W-31-109-eng-38. 51p.

The dynamics of two-phase flow through the coolant channels of a natural-circulation boiling water nuclear reactor is studied analytically. One-dimensional conservation equations describing the flow through each channel are written in the linearized perturbed form and Laplace transformation in time is performed. A systematic procedure is developed to approximate the solution. The solution may be oscillatory both in time and space, and the stability depends largely upon the steady-state profile of velocity and void fraction along the channel, as well as the channel length. The simplifying assumption made by earlier investigators that the slip ratio is constant along the channel length is shown to yield results close to the true solution. The solution gives the space-time dependent transient steam void fraction, which when multiplied by the reactivity worth of void yields the space-time dependent void reactivity. Coupling between parallel channels due to a common downcomer is investigated. Several specific problems are considered and the predicted solutions are substantiated by comparison with those obtained through elaborate numerical methods and previous observations. The analytical techniques developed are applicable to both natural- and forced-circulation systems. (auth)

40780 (EUR-1643.e(p.205-27)) FAST AND EPITHERMAL NEUTRON SPECTROMETRY IN THERMAL REACTORS BY MEANS OF ACTIVATION MEASUREMENTS. M. Bresesti, A. M. Del Turco, and A. Rota (European Atomic Energy Community. Joint Nuclear Research Center, Ispra, Italy).

Activation techniques were investigated for the determination of fast- and epithermal-neutron spectra. For fast-neutron spectrometry in the 1 to 10 Mev energy range, a set of threshold detectors was used. The activation data were processed using the $\sigma(E)$ values of the threshold reactions. A new series-expansion method was developed where the series-expansion coefficients are obtained by solving a least-square problem. The epithermal neutron spectra were obtained, in the 1 to 300 ev energy range, with the aid of a set of resonance reactions. The activation data were processed, using the $\sigma(E)$ values obtained by the Breit-Wigner formula from the resonance parameters, by a method based on the utilization of polynomial functions. The data processing was carried out with the IBM 7090 digital computer. (auth)

40781 (KAPL-3061) ZAP—A PROGRAM FOR THE ANALYSIS OF SPACE TIME KINETICS WITH XENON FEEDBACK. H. H. Rubin (Knolls Atomic Power Lab., Schenectady, N. Y.). June 30, 1964. Contract W-31-109-eng-52. 20p.

Using the semidirect variational method, the space- and time-dependent neutron kinetic equations can be reduced to a system of integro-differential equations in the time domain. The space- and time-dependent neutron flux is represented by the sum of the products of time-dependent coefficients and space modes. To avoid the difficult task of determining orthogonal eigenfunctions for a modal expansion of the neutron flux in a complex geometry, non-orthogonal Green's function modes, which are obtained from an approximate solution of the integral form of the multigroup kinetic equations, are used. The ZAP program first calculates the Green's function space modes, which serve as weighting functions for averaging the time-dependent diffusion parameters. ZAP then solves the Euler-Lagrange equations, which were obtained from the semidirect variational method, for the time-dependent coefficients used in the modal expansion. These equations are solved using linear analysis techniques. The major mode of feedback considered is due to the xenon dynamics. (auth)

40782 (KR-84) MEASUREMENTS OF ρ^{28}, δ^{25} AND INITIAL CONVERSION RATIOS IN LATTICES OF 3% ENRICHED UO_2, MODERATED BY MIXTURES OF LIGHT AND HEAVY WATER. D. C. Perricos (Norway. Institutt for Atomenergi, Kjeller). May 1964. 24p. (NORA-17)

The cell parameters ρ^{28}, δ^{25} and initial conversion ratios were measured for two H_2O/D_2O ratios and different moderator-to-fuel volume ratios. These parameters were measured applying radiochemical separation techniques developed within the NORA Project. The method used for the measurements avoids the introduction of cadmium in the lattice and is based on thermal and lattice irradiations, normalized to a common integrated thermal neutron flux by the use of dysprosium foils. A description of the method used is given together with results obtained from the lattices studied. (auth)

40783 (KR-87) ANALYSIS OF NEUTRON SPECTRA IN UO_2 LATTICES MODERATED BY MIXTURES OF LIGHT AND HEAVY WATER, USING RESONANCE DETECTOR FOILS. J. Smit (Norway. Institutt for Atomenergi, Kjeller). May 1964. 18p. (NORA-18)

This report describes a new experimental technique for measuring a spectrum index S_i, defined as S_i(1 resp 2) = [($^{176}Lu/^{63}Cu$ resp ^{164}Dy) activation ratio in experiment]/[($^{176}Lu/^{63}Cu$ resp ^{164}Dy) activation ratio in a pure thermal spectrum] in a unit cell as a function of the distance from the center of the fuel rod. These measurements were carried out in the zero-power critical facility NORA for two different D_2O concentrations in the moderator (81 and 55%).

The experimental results are compared with the theoretical curves calculated by the K-7 THERMOS code. (auth)

40784 (NAA-SR-9772) MATERIAL BUCKLINGS OF CRITICAL AND SUBCRITICAL URANIUM CARBIDE FUELED GRAPHITE ASSEMBLIES. PART II. THEORETICAL INTERPRETATION. E. R. Specht (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Aug. 1, 1964. Contract AT(11-1)-Gen-8. 47p.

Material bucklings for uranium carbide fuel elements, enriched to 3.02 wt % of uranium-235, were obtained from critical and subcritical assemblies. The fuel elements were placed in a graphite assembly on triangular lattice pitches of 9, 11, and 12 inches. Four-group theory was used to infer material bucklings from 12 "two-region" critical mass measurements. Material bucklings were obtained from 22 subcritical assemblies consisting of 31, 23, and 19 cells set at pitches of 9, 11, and 12 inches. The large differences observed (up to 3.4 m^{-2}) between the critical and uncorrected subcritical values of B_m^2 are shown to be due to diffusion anisotropy and the use of calculated rather than measured radial bucklings in the subcritical experiments. Multigroup (15 energy group) cell calculations give material bucklings that agreed very well with those inferred from the critical assemblies. (auth)

40785 (WAPD-TM-427) RECAP-2—A MONTE CARLO PROGRAM FOR ESTIMATING EPITHERMAL CAPTURE RATES IN ROD ARRAYS. N. R. Candelore and R. C. Gast (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Apr. 1964. Contract AT-11-1-GEN-14. 61p.

The calculation of epithermal capture rates in a hexagonal or square array of rods by Monte Carlo methods is described in a Fortran program for the Philco 2000. Each rod may contain at most three annuli. Doppler broadened resonance cross sections for as many as five nuclides, each having at most 50 resonances in the resolved energy range and having unresolved resonances constructed by use of Porter-Thomas distributions, are contained in the cross section library. In addition, five nonresonance nuclides with 1/v absorption properties and constant scattering are permitted. Any region may contain any or all of the above ten isotopes, thus permitting studies of resonance interference effects. The resonance capture probabilities are calculated using a Σ_a/Σ_T estimator. Smooth and resonance captures are edited separately. (auth)

40786 THE CRITICAL ASSEMBLY OF REACTOR STATION GEESTHACHT. H. Wrobel, H. C. Gade, and H. Danne (Gesellschaft für Kernenergieverwertung in Schiffbau und Schiffahrt mbH, Geesthacht, Ger.). Atomkernenergie, 9: 253-8(July-Aug. 1964). (In German)

The critical assembly, installed at the Reactor Station Geesthacht, was put into operation in May 1964. The plant consists of an experimental hall and a service building connected to the hall by an air lock. It will be possible to test both solid and liquid moderators. In the experiment hall a machine was installed that has fixed and mobile tables with which the two core halves of the reactor can be separated for loading. The laboratories, the control room, and the rooms containing auxiliary equipment are placed in the service building. The nuclear instrumentation and the switchboard are mounted in the control room. (auth)

40787 THE CRITICAL ASSEMBLY KNK. A. Brandstetter and H. Hennies (INTERATOM Internationale Atomreaktorbau GmbH, Bensberg, Ger.). Atomkernenergie, 9: 259-62(July-Aug. 1964). (In German)

The first experimental program with the critical facility at the Geesthacht reactor station will be carried out with the KNK critical assembly. KNK consists of a matrix made up of aluminum tubes that are to be loaded with fuel, moderator, and reflector rods. Shut-down of the facility is achieved by separating mechanically the two matrix halves, by pushing fuel out of reactor core, and by inserting poison rods. A series of specific test equipment was planned including a pile oscillator used to periodically thrust small samples into and out of the reactor core. (auth)

40788 EASY CALCULATION OF REACTOR STABLE PERIODS. E. Oliveri (Università, Palermo, Italy). Energia Nucl. (Milan), 11: 384-6(July 1964).

Equations for determining reactor stable periods that are fairly good for small reactivities, e.g., $\rho = 0.00100$ or less, are extended for use with larger reactivities. (C.E.S.)

40789 CALCULATION OF CRITICAL STATE OF A "BOILING" REACTOR. Yu. A. Platovskikh (Central Scientific-Research Inst., Academy of Sciences, USSR). Inzh. Fiz. Zh., Akad. Nauk Belorussk. SSR, 7: 92-5(May 1964). (In Russian)

Critical condition of a boiling reactor is considered on the basis of a non-stationary diffusion equation with coordinate-dependent coefficients. To determine the criticality factor the perturbation theory is used with account for the second-order terms. (auth)

40790 THE EFFICIENCY OF ARBITRARY CONFIGURATIONS OF RODS PARTIALLY INSERTED INTO A CYLINDRICAL MULTI-LAYER REACTOR. H. Kiesewetter (VEB Atomkraftwerk, Berlin). Kernenergie, 7: 368-75 (June-July 1964). (In German)

A method was developed for calculating the efficiency of various configurations of rods partially immersed into a cylindrical multilayer reactor and for the determination of the critical immersion depth, critical buckling, flow distribution, and thermal nonhomogeneities for the critical state. The calculation method involves determination first of the equations for the totally immersed rod, followed by the determination of the corresponding functions for each layer. The techniques involved in the calculations and determinations involved are presented in detail. All types of rod-shaped heterogeneities such as control rods, rods with highly enriched fuel, nonabsorbing lower parts of control rods, water, or air holes may be equally included in the calculation. (M.C.G.)

40791 THE EFFECT OF BURNABLE POISONS ON THE BURN-UP BEHAVIOR OF A THERMAL REACTOR DURING DIFFERENT REGIMES OF OPERATION. P. Wenzel (VEB Atomkraftwerk, Berlin). Kernenergie, 7: 375-80 (June-July 1964). (In German)

The effects of a burnable absorber, homogeneously distributed in the fuel, on the attainable average specific burnup and on the reactivity variations during burnup were investigated under various conditions of fuel operating conditions, neutron flux distribution, and power density. An analytical approximating method was developed on the basis of the one-group perturbation theory. The numerical evaluation of the implicit final equations was conducted by means of iteration with the aid of digital computers. Quantitative data are obtained on advantageous factors such as regulating capacity economies and on disadvantageous factors such as reduced burnup, for each operating condition investigated. (M.C.G.)

40792 ON THE FORMATION OF A FUNDAMENTAL MODE SPECTRUM IN A FAST INSERT INTRODUCED INTO THE REACTOR RRR. H. U. Barz (Zentralinstitut für Kernforschung, Rossendorf, Ger.). Kernenergie, 7: 391-7 (June-July 1964).

The Argonaut-type RRR reactor at the Central Institute for Nuclear Research was found to be suitable for introducing fast insets with certain compositions. Under suitable conditions the fundamental mode spectrum forms in the region surrounding the center of the fast inset. Thus, this technique is a suitable means for investigating various fast-reactor compositions. The methods employed and the type of results obtainable are illustrated on an example involving the sodium portion of a diluted system. It was found that the formation of a fundamental mode spectrum depends very much on the blanket thickness and that the natural uranium blanket should be about 6 cm thick. (M.C.G.)

40793 PILE OSCILLATOR MEASUREMENTS AT THE SIEMENS-UNIVERSITY-REACTOR SUR. P. Hoehne (Siemens-Schuckertwerke AG, Garching, Ger.). Kerntechnik, 6: 355-61(July-Aug. 1964). (In German)

The pile oscillator at the 0.1-w reactor is described, and oscillator measurements of the Westcott parameters of the reactor spectrum are summarized. Other applications of the oscillator are considered. (D.C.W.)

40794 THE NORDHEIM-FUCHS EXCURSION MODEL WITH NON-LINEAR REACTIVITY FEEDBACK. B. Wolfe, (General Electric Co., San Jose, Calif.). Nucl. Sci. Eng., 20: 238-40(Oct. 1964).

It was previously shown that serious error can result if one uses an average value for the heat capacity in the Fuchs-Nordheim reactor excursion model when, in fact, the heat capacity varies with temperature. Two lemmas are proved which permit easy insight into this point and in addition, generalize to include cases of both a temperature-dependent heat capacity and a temperature-dependent temperature coefficient. (C.E.S.)

40795 A SIMPLE METHOD OF FITTING SOFOCATE THERMAL CONSTANTS FOR HIGHLY ENRICHED WATER MODERATED REACTORS. K. R. Teare (Rolls-Royce and Associates Ltd., Derby, Eng.). Nucl. Sci. Eng., 20: 240-4 (Oct. 1964).

A method which enables fitted SOFOCATE constants to be obtained by hand calculation or with very small expenditure of computer time is described. The scheme is based on the fact that for hydrogen moderated mixtures with approximately 1/v absorption, the SOFOCATE spectrum, and hence the spectrum average of any cross section, is a function of only two variables, the moderator temperature and the ratio of 2200 m/s macroscopic absorption cross section to the hydrogen number density. (C.E.S.)

40796 USE OF A KINETIC METHOD FOR DETERMINATION OF LOCATION-DEPENDENCE OF THE EFFECTS OF FAST NEUTRONS IN A REACTOR AS WELL AS FOR POWER CALIBRATION. Theodor Stribel (Siemens-Schuckerwerke AG, Garching, Ger.). Nukleonik, 6: 193-5(July 1964). (In German)

A kinetic method for measurements carried out with a Siemens-Argonaut Reactor (SAR) is described. The spatial distribution of the fast effect is determined from the linear increase of the neutron number by the introduction of a source into the critical reactor. Furthermore, the possibility follows therefrom to determine either the strength of the neutron source, or, in case this is known, to obtain a power calibration of the reactor. Besides, the possibility is given, in principle, to determine experimentally the effective part of the delayed neutrons with a known source strength and given power calibration. (tr-auth)

40797 ON THE BEST MEAN DECAY CONSTANT FOR REACTOR KINETICS EQUATIONS WITH ONE GROUP OF DELAYED NEUTRONS. Aldo Belleni-Morante (Università, Florence). Nukleonik, 6: 209-11(July 1964).

The best mean decay constant for one-group kinetics is calculated using linear operator theory and the integral form of the reactor kinetics equations. (auth)

40798 GRUPPOVYE KONSTANTY DLYA RASCHETA YADERNYKH REAKTOROV. (Group Constants for Nuclear Reactor Calculations). L. P. Abagyan, N. O. Bazazyants, I. I. Bondarenko, and M. N. Nikolaev. Moscow, Atomizdat, 1964. 140p.

The principles of formulation and uses of multigroup constants including a review of group constants, selection of group energy interval, group averaging of macroscopic cross sections, group averaging of effective cross sections for specific elements, calculations for heterogeneous resonance effects, determination of moderation, and rules for use of system constants are discussed. Fission cross sections, average number of secondary neutrons, fission neutron spectra, capture cross sections, and elastic and inelastic scattering are considered. Group constants for various media are tabulated. A bibliography of 578 references is included. (C.E.S.)

40799 A STABLE NUMERICAL SOLUTION OF THE REACTOR KINETICS EQUATIONS. Billy V. Koen and K. F. Hansen (Massachusetts Inst. of Tech., Cambridge). 5p. (CONF-446-29)

From American Nuclear Society 10th Annual Meeting, Philadelphia, June 1964.

A numerical procedure for solving the reactor kinetics equations is developed, which is numerically stable for all time steps, independent of the reactivity or reactor period. Further, the asymptotic numerical solution is shown to equal the asymptotic analytic solution in the case of constant reactivity. (T.F.H.)

40800 REACTOR PULSE PROPAGATION THROUGH GRAPHITE. G. H. Miley and P. K. Doshi (Univ. of Illinois, Urbana). 5p. (CONF-446-32)

From American Nuclear Society, 10th Annual Meeting, Philadelphia, June 1964.

The theory of reactor pulse propagation through graphite columns is shown. Experiments using a $4 \times 4 \times 5.8$ ft thermal column yield a value $Dv = (2.35 \pm 0.02) \times 10^5$ cm^2/sec for reactor grade graphite having a density of 1.60 g/cm^3. (T.F.H.)

40801 TEMPERATURE OPERATION OF AN UNPRESSURIZED NATURAL URANIUM HEAVY WATER ASSEMBLY. D. G. Andrews (Univ. of Toronto) and I. F. Freibergs. 19p. (CONF-446-15)

From American Nuclear Society 10th Annual Meeting, Philadelphia, June 1964.

Buckling measurements have been made on subcritical lattices consisting of 1-inch-diameter natural-uranium rods in square lattices in heavy water, using traversing BF_3 counters. Lattice pitches of $3\frac{1}{2}$, $5\frac{1}{4}$, and 7 in. have been used, at temperatures ranging from 18 to 90°C, leading to figures for the temperature coefficient of buckling $-(dB^2/dT)$ over the range 20 to 80°C. (auth)

Design and Feasibility

40802 VARIOUS APPLICATIONS OF THE 630 A NUCLEAR STEAM GENERATOR OF THE GENERAL ELECTRIC COMPANY. H. G. Schafstall (Brown-Boveri Krupp Reaktorbau GmbH, Mannheim, Ger.). Kerntechnik, 6: 333-8(July-Aug. 1964). (In German)

The application of a 630 A unit with a shaft power of 10,000 hp to ship propulsion is described; and the use of a

stationary 630 A unit for the combined purpose of electric power generation, radioisotope production, and promotion of chemical processes by irradiation is discussed. (D.C.W.)

40803 STUDIES ON SEMI-HOMOGENEOUS REACTOR AND AQUEOUS HOMOGENEOUS REACTOR. Eizaburo Nishibori. Nippon Genshiryoku Gakkaishi, 6: 358-60(June 1964). (In Japanese)

Studies on a high-temperature, gas-cooled reactor with semi-homogeneous fuel were started in JAERI in 1958. Liquid bismuth as well as helium was considered as coolant. The main items studied under the JAERI program are described. An aqueous homogeneous reactor program is also reviewed. The main activities were critical experiments and analyses of a homogeneous heavy-water system, studies on the behavior of a thorium oxide slurry, and a preliminary mock-up experiment for a boiling-slurry reactor concept. (auth)

40804 NUCLEAR REACTOR. John F. Gibbons (to General Nuclear Engineering Corp.). Canadian Patent 694,321. Sept. 15, 1964. Priority date Dec. 20, 1960, United States.

In this boiling water reactor, a steam and water drum is placed above the core in the pressure vessel. The water is pumped from the vessel to the drum where the steam is separated and then conveyed to the point of use. The longitudinal fuel elements are cooled by water circulated in vertical passages joined to a plenum chamber. (F.S.A.)

Fuels

40805 (AAEC/E-120) EQUIVALENCE RELATIONS FOR RESONANCE ABSORPTION IN SMALL PARTICLES. A. Keane (Australia. Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales). May 1964. 15p.

The effective resonance integral for fertile material agglomerated into small particles can be evaluated to a good approximation by using a reduced scattering cross section per fertile nucleus. The proportion of the moderator scattering per nucleus obtained from two extreme assumptions was checked against the exact solution for spherical particles. (auth)

40806 (EUR-1643.e(p.301-25)) DIRECT ENERGY CONVERSION BY THERMIONIC EMISSION. H. Neu, J. Bohdansky, C. Busse, C. Cappelletti, R. Caron, H. Schins, H. Strub, and C. Zanantoni (European Atomic Energy Community. Joint Nuclear Research Center, Ispra, Italy).

The direct conversion of nuclear fission heat into electricity by cesium-filled diodes operating inside a reactor core was studied in a program concentrated on high-pressure, high-temperature converters. Two in-pile tests with experimental converters were carried out, the maximum electrical power output being about 40 watts with a conversion efficiency of about 11%. The behavior of the emitter heating system used in the in-pile experiment (Mo emitter heated by radiation from a (UZr)C fuel pin) was studied out-of-pile, where nuclear fission heat was simulated by electron bombardment. The change in the emitter work function owing to evaporated fuel was measured under different conditions of fuel outgassing and at different temperatures. The maximum obtainable efficiency of in-pile converters with high cesium vapor pressure and refractory metal emitters is discussed. According to the conclusions reached, about 14% could be achieved with a Re-emitter at 1800°K and an interelectrode spacing of 0.24 mm. Higher efficiencies are probably to be expected with absorbed electronegative gas layers on the emitter or collector surface. The results of a preliminary analysis of fast reactor sizes and performances for various converter cell geometries are given and suggest that for a thermal power of 3 Mw the pin diameter could be 14 mm and the core volume 46 l. (auth)

40807 (GEAP-4264) UO_2 FUEL ROD OPERATION WITH GROSS CENTRAL MELTING. M. F. Lyons, R. C. Nelson, T. J. Pashos, C. R. Wilson, and B. Weidenbaum (General Electric Co. Vallecitos Atomic Lab., San Jose, Calif.). Oct. 31, 1963. Work Performed under United States–Euratom Joint Research and Development Program. Contract AT(04-3)-189. 204p. (EURAEC-1182)

A fuel assembly (EPT-12C) containing UO_2 pellets was irradiated at extreme thermal performance conditions sufficient to produce gross central melting. Based on loop calorimetry, the peak surface heat flux at startup averaged over the four rods in the assembly was 1.3×10^6 Btu/hr-ft^2. The calculated peak surface heat flux of the maximum power rod was 1.4×10^6 Btu/hr-ft^2. Analysis indicates more than 70% of the UO_2 cross section was melted at the peak heat flux location during operation. The thickness of the remaining, unmelted UO_2 rim adjacent to the cladding was approximately 40 mils (0.1 cm). During its initial 55 days of operation, the assembly attained an average burnup of 5300 Mwd/T_e (1.4×10^{20} fissions/cm^3) and sustained 22 significant power cycles without difficulty. An interim examination of the fuel assembly at the 5300 Mwd/T_e (1.4×10^{20} fissions/cm^3) burnup level showed the fuel rods to be visually and dimensionally identical to the pre-irradiation conditions. (auth)

40808 (GEAP-4704) DECAY HEAT CALCULATION METHODS FOR LOW-ENRICHMENT ROD TYPE FUEL ELEMENTS. E. R. Craig (General Electric Co. Vallecitos Atomic Lab., San Jose, Calif.). Aug. 1964. Work Performed under United States–Euratom Joint Research and Development Program. Contract AT(04-3)-189. 31p. (EURAEC-1188)

Methods of calculating the decay heat of low-enrichment, rod-type fuel elements, as well as how results are applied in transfer and hot cell operations, are given. The limiting parameter in all cases is the surface temperature of the cladding, which must be kept below 400°F to prevent post-irradiation metallurgical changes which could cause confusion in the interpretation of the results of the hot cell examination. The decay heat of an AEC-EURATOM fuel assembly (EPW 6/8 V), which was irradiated for one cycle in the Pressurized Water Loop (PWL) at General Electric Test Reactor (GETR), is reported. Normally it has been desirable to ship the fuel assembly to the Radioactive Materials Laboratory (RML) as quickly as possible after irradiation while not exceeding the maximum fuel surface temperature of 400°F. Methods are shown for approximating how soon after shutdown the loop main and standby coolant circulation may be shut off and the element transferred from the loop to a water-filled can. One criterion for loading the element into the can at this time is based on the maximum heat flux that can be tolerated under natural circulation conditions and still maintain a surface temperature below 400°F. Measured data were compiled to predict accurately the surface temperature of a fuel rod inside a flow tube after it was transferred into the RML hot cell ambient air from the water-filled transfer can. To obtain the required data an electrically heated rod with a thermocouple attached to the surface was operated both inside the flow tube and in ambient air conditions free of

the tube. The maximum heat flux obtained which satisfied the 400°F maximum surface temperature requirement was used in the decay heat calculations. Methods are shown for calculating the cooling time requirements for elements irradiated for a finite period in a constant neutron flux. Whenever the cooling time is much longer than the exposure period, the exposure may be treated as a burst of fissions that occurred at the midpoint of the reactor irradiation. If an element has been irradiated for more than one cycle, the heat flux contribution of the previous irradiation must be considered in calculating the various cooling intervals. A series of tests were performed to check the heat transfer in the Vallecitos Boiling Water Reactor (VBWR) single-element cask. These tests provide a reasonable approximation of maximum cladding surface temperature if an element is shipped dry. (auth)

40809 (HW-75521) CLERK—A CROSS SECTION AVERAGING ROUTINE. G. J. Busselman (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Nov. 12, 1963. Contract AT(45-1)-1350. 18p.

The CLERK programs, for IBM 7090, are designed to provide a means of forming flux-weighted one-group cross sections for fuel burnup calculations. CLERK I, formerly known as CLERK JAYNE, uses a set of 16-group fast reactor cross sections, whereas CLERK II, otherwise known as CLERK BRIGITTE, uses up to 10 groups and up to 15 isotopes. All cross sections are included as input. (R.E.U.)

40810 (NAA-SR-9637) POST-IRRADIATION EXAMINATION OF SURFACE FILM FORMATION ON OMRE DRIVER ELEMENT NO. 219. R. J. Sullivan, R. B. Cassidy, H. Mandel, and R. T. Keen (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Aug. 1, 1964. Contract AT-11-1-GEN-8. 38p.

Methods of hot cell examination of the fuel plates of an OMRE stainless-steel clad fuel element after 282 Mwd irradiation to determine the extent and composition of surface film deposits are described and discussed. The fuel plates, examined after removal following the Core II irradiation cycle, showed thin film deposits which followed the burnup profile on the fuel plate. Measurements showed that the film increased from ~0.2 μ at the inlet end of the fuel plates to a maximum of 3.5 to 3.6 μ at the high flux area of the plates and diminished to ~0.9 μ at the outlet end. The average fouling rate was observed to be 0.007 μ/Mwd and 0.036 μ/operating day. Examination indicated that the film deposits consisted of particles ~1 μ in dia. containing an inorganic center composed primarily of magnetite surrounded by an organic matrix. (auth)

40811 (NAA-SR-Memo-9555(Rev.)) SHIPPING OF FUEL RODS FROM ATOMICS INTERNATIONAL TO HALLAM; ASSEMBLE AND STORE 171 URANIUM CARBIDE FUEL ASSEMBLIES AT HALLAM. Feasibility Report. P. P. Gaines (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Jan. 31, 1964. Contract [AT(11-1)-Gen-8]. 22p.

The required 171 fuel elements contain less than 27,000 kg of U metal. The fabrication of UC fuel rods was described in TDR NAA-SR 8935. Operations described encompass transporting fuel rods from Atomics International to Hallam, storage and assembly of fuel elements, and replacement of spent fuel elements with new fuel elements. Storage and handling criteria are established and diagrams of facilities and flow charts are included. Procedures are referenced to documents outlining accountability, quality control, security, health and safety, and criticality. (auth)

40812 (NP-10375) STORAGE AND UNLOADING POND SHIELDING REQUIREMENTS. Status Report. W. Schuller (European Company for the Chemical Processing of Irradiated Fuels, Mol, Belgium). Nov. 21, 1960. 6p. (ETR-92)

A detailed shielding calculation shows that only 180 cm of water is required above the top of a vertically suspended fuel element in the unloading pond if the working time for the actual lifting operation is limited to a maximum of 2 hr/week for each operator. The permanent storage of a large number of fuel elements in the proposed manner (4 elements per bucket, bucket center lines on 1 × 1 m square grid) requires 315 cm of water above the top of the elements in order to reduce the radiation to the MPL of 100 mRem/week above the pool surface. Calculations in both cases are based on the fuel element with the highest specific activity (BR3: 5940 Mwd/ton U, 1.21×10^6 Curie/ton U). (auth)

40813 (NP-10417) DISSOLUTION OF ALUMINUM CLADDING WITH SODIUM HYDROXIDE. Status Report. J. Van Caneghem, Y. Marchant, J. Alen, and A. Perales-Medina (European Company for the Chemical Processing of Irradiated Fuels, Mol, Belgium). Dec. 2, 1960. 18p. (ETR-93)

The dissolution of Al cladding was studied on laboratory scale in a batch and a semicontinuous system. For the batch system a flowsheet was developed that avoids Al_2O_3 precipitation during dissolution and allows, by final NaOH concentration adjustment, obtaining a stable decladding solution. In the semicontinuous system the parameters that affect the dissolution rate and the $NaAlO_2$ and NaOH concentration in the decladding solution were studied. (auth)

40814 (ORNL-TM-893) CALCULATIONS FOR VENTILATED FUEL ELEMENT CONFIGURATIONS. R. B. Evans, III, and G. M. Watson (Oak Ridge National Lab., Tenn.). Sept. 1964. Contract W-7405-eng-26. 26p.

The results of simplified calculations are reported comparing the release of fission gases into the coolant in two ventilated-fuel-element configurations that are being considered for use in high-temperature, gas-cooled, reactors. One configuration was a bare, porous, hollow cylinder with helium flowing through the matrix sweeping fission gases into the central void space to be exhausted. The other configuration consisted of a cylindrical fueled matrix enclosed by a gas annulus and a porous sleeve with helium flowing through the sleeve to sweep fission gases out of the annulus. The calculations show that, for identical surface temperatures, power output per unit length, and specific helium flushing rates, the sleeved fuel element is approximately 10,000 times more efficient in preventing fission-gas contamination of the coolant than the bare fuel element. A third configuration, a bare fuel element with an unfueled peripheral shell (no gas annulus), appears to be a logical extension of the present comparisons. Similar calculations will be made for this case in the future. (auth)

40815 (TID-21061) DISPERSED URANIUM MONOCARBIDE–URANIUM NUCLEAR FUEL MATERIAL (thesis). Anthony John Mione (North Carolina State Coll., Raleigh). 1963. Work Performed under United States–Euratom Joint Research and Development Program. Contract AT(40-1)-2981. 89p. (AD-438919)

The factors affecting the production of a nuclear fuel material consisting of a fine, uniform dispersion of UC, in a U metal matrix were determined. Theoretical considera-

tions indicated that a uniform dispersion of small, hard particles in U fuels would eliminate the swelling associated with release of fission gas products during irradiation that severely limits the usefulness of U fuel elements. UC was selected for the dispersed phase because of its excellent combination of physical and nuclear properties. (auth)

40816 (UCRL-6148) ESCAPE OF FISSION PRODUCTS FROM UO_2-LOADED BeO FUEL ELEMENTS. H. G. Hicks and J. C. Armstrong, Jr. (California. Univ., Livermore. Lawrence Radiation Lab.). Jan. 12, 1961. Contract W-7405-eng-48. 32p.

The escape of fission products from a BeO-UO_2 ceramic fuel element was studied as a function of temperature from 1225 to 1500°C. The elements Mo, I, Te, Cs, Ba, Ce, Y, Nd, and Zr were investigated at several temperatures, Xe at 1400°C only. (auth)

40817 PLUTONIUM-BEARING FUELS. Power Reactor Technol., 7: No. 2, 167-86(Spring 1964).

A reasonably comprehensive picture of the present status of plutonium-bearing fuel element development is presented. Information is included on the fabrication, history, properties, development, design, and irradiation behavior of plutonium compounds and their use in plutonium-bearing fuel elements. 55 references. (N.W.R.)

40818 PLUTONIUM-CONTAINING ALUMINUM-BASE ALLOY FOR FUEL OF NUCLEAR REACTORS. Clrence H. Bloomster and Yeichi B. Katayama (to U. S. Atomic Energy Commission). Canadian Patent 693,506. Sept. 1, 1964. Priority date Sept. 21, 1960, United States.

The alloy contains 1-10% plutonium, 2-3.5% nickel and up to 0.7% iron, the remainder being aluminum. To prepare the alloy fuel, the metals are heated to 725-750°C and poured molten into a graphite mold at room temperature. (C.E.S.)

40819 COHERENT NUCLEAR REACTOR ELEMENTS. Joseph H. Handwerk and Eugene D. Lynch (to U. S. Atomic Energy Commission). Canadian Patent 694,374. Sept. 15, 1964. Priority date May 17, 1961, United States.

These fuel elements consist of 10 to 90 wt % of discrete particles of a conventional binder glass and from 10 to 90 wt % of an additive selected from U_3O_8, UO_2, UN, PuN, UC, PuC, US, PuS. The fuel elements have a metal cladding. Not less than one wt % of conventional glass making materials are mixed with the actinide oxide additive and compacted at 15,000 to 60,000 lb f/in.^{2} pressure and at a temperature of 400 to 700°C. (C.E.S.)

Power and Power-Breeder Reactors

Refer also to abstract 40008.

40820 (AAEC/E-122) THE AUSTRALIAN HIGH-TEMPERATURE GAS-COOLED REACTOR RESEARCH PROJECT. K. F. Alder and W. H. Roberts (Australia. Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales). July 1964. 20p.

A brief history is given of activities at the Lucas Heights Research Establishment and the reasons that led to the selection of beryllium oxide for investigation as a promising moderator material in high-temperature gas-cooled reactor systems. The choice of a pebble-bed core for an initial design study of an actual reactor is discussed; the results to date and an outline of the future program are presented. (auth)

40821 (APED-4285) VBWR NOISE ANALYSIS. P. R. Pluta (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). Mar. 30, 1964. 74p. (64-APE-13)

Neutron flux and in-core flow data taken at the Vallecitos Boiling Water Reactor were analyzed statistically in both the time and frequency domains. The results were found to be not directly useful for improving our understanding of reactor dynamics. However, a procedure is given that integrates noise results with a complete dynamic model of a BWR plant and may result in both quantitative and qualitative improvements. The report summarizes experience in reactor noise analysis, including details of the digital computer code, DART, used to reduce most of the noise data reported on the VBWR. (auth)

40822 (APED-4463) VALLECITOS BOILING WATER REACTOR RECIRCULATION LOOP FLOW DECAY TESTS. G. L. Davis (General Electric Co. Vallecitos Atomic Lab., San Jose, Calif.). Feb. 15, 1964. 17p.

The flow decay was measured by simultaneously shutting off power to both recirculation pumps and recording flow-versus-time on a Sanborn recorder. The time constants of the measuring instruments were measured during a preliminary test and this information was used to correct the measured curve. The decay characteristic as measured and corrected is plotted along with the decay characteristic assumed for use in Amendment 51 to the VBWR License Application. The flow during the period of concern is always above that assumed for the amendment. It had been expected that the measured flow would exceed that assumed for Amendment 51 since the assumptions were considered to be conservative. During the calibration of the recorder for these runs, sufficient data were collected to allow the pump characteristics to be checked against the characteristics supplied by the pump manufacturer. These curves are shown. (auth)

40823 (BAW-164) CONSOLIDATED EDISON THORIUM REACTOR. DETERMINATION OF POWER DISTRIBUTION IN THE CETR BY MEASUREMENT OF LANTHANUM-140 ACTIVITY. M. C. Edlund, J. C. Deddens, W. R. Smith, and R. H. Lewis (Babcock and Wilcox Co., Lynchburg, Va.). Sept. 1961. For Consolidated Edison Co. of New York, Inc. 8p.

An operational plan is described in which selected fuel elements are removed from the Consolidated Edison Thorium Reactor (CETR) after a reasonable period. Power distribution in the CETR is determined from measurement of ^{140}La gamma activity in the fuel elements. (J.R.D.)

40824 (BMI-1676) A STUDY OF ROTARY SHAFT-SEALING CONCEPTS FOR PRESSURIZED-WATER REACTOR APPLICATION. Daniel R. Grieser, William G. Rieder, L. E. Hulbert, J. Clarence Bell, John C. Smith, and C. Malcolm Allen (Battelle Memorial Inst., Columbus, Ohio). June 30, 1964. Work Performed under United States-Euratom Joint Research and Development Program. Contract W-7405-eng-92. 100p. (EURAEC-1189)

The objective of the program was to develop principles for the design of dynamic seals for pressurized-water applications. On the basis of a review and evaluation of the literature and state-of-the-art of water sealing, the mechanical face type and packed gland type seals were selected and intensively studied. The research was concentrated upon a detailed study of the interfacial behavior. Experiments with face seals have revealed hydrodynamic films of water capable of supporting light face loads. The lubrication by these films and the leakage are affected im-

portantly by flexural distortion of the seal components produced by the sealed pressure. An analysis of this distortion was developed, even for complex seal shapes, and this theory promises to be useful in seal design. The computer program, which was developed, will permit an evaluation of distortion of potential seal designs for high and varying pressure applications. For the first time, an analytical technique is available that will permit design modifications to face seals to be accurately evaluated. It would seem that the program has the capability of evaluating primary face seal component geometries that will provide for the maintenance of a parallel and predictable leakage gap. Such a tool is extremely valuable in providing and maintaining the pressure balance in face seals for high and variable pressure applications. Possible causes for the existence of the lubricating films were sought by measuring seal face topography and motions carefully. Together with tentative lubrication theories, these measurements indicate that several such causes may be active, although precise evaluation of their effects cannot be made now. Visual, photographic, and thermal studies of packed gland seals showed the importance of heat transfer to the life of this type of seal. Interfacial vaporization is widespread. Yet there is a potentiality for hydrodynamic lubrication, which seems to be improved by skewing the packing, though this also tends to increase the leakage somewhat. Pressure measurements made in the interface compared well with previously published results. By inverting and skewing the packing, the seal is insensitive to increases in packing loads and sliding velocities—problems so common to convention packed-gland seals. Analysis of the frictional behavior of inverted and skewed seals indicates that improved hydrodynamic lubrication is obtained with this geometry. (auth)

40825 (CVNA-210) CAROLINAS VIRGINIA NUCLEAR POWER ASSOCIATES, INC., RESEARCH AND DEVELOPMENT PROGRAM QUARTERLY PROGRESS REPORT FOR THE PERIOD, JANUARY–MARCH 1964. (Westinghouse Electric Corp. Atomic Power Div., Pittsburgh). Contract AT(30-1)-2289. 55p.

The header cavity insulation was replaced and the physics testing was resumed. This included temperature and pressure coefficient measurements and hot control rod calibrations. Radiation surveys exterior to the vapor container were taken for reactor power levels between 30 and 37 Mw thermal. Basic concrete shielding design is given. Thermal-hydraulic operating characteristics of the core at proposed elevated power are being analyzed. Hot rod calibrations were performed for two rod groups at two temperatures and flux wire data were obtained for seven control rod configurations. The design for the testing facility for ultrasonic inspection of pressure tubes is given. The metallurgical examination of CVTR components is evaluated. (N.W.R.)

40826 (EUR-1830.e(Pt.I)) EURATOM'S SCIENTIFIC ACTIVITIES. ORGEL PROGRAM—THEORETICAL AND CONCEPTUAL STUDIES. (European Atomic Energy Community). 1964. 434p.

A general view of the present development stage of the ORGEL project, i.e., the study of a heavy water-moderated, organic-cooled reactor is given. The first part deals with the theoretical and conceptual studies (250 Mw(e) power plant studies, reactor physics, use of enriched uranium or thorium, and economic perspectives); the second part outlines the experimental studies and results on the materials involved in an ORGEL reactor, i.e., organic coolants (study of the physical properties and of the thermal and radiation behavior), structural materials (development of methods for the fabrication of sintered aluminum-alumina mixtures, studies into the compatibility of zirconium alloys with the organic liquid), and fuel materials (development of a massive uranium carbide fuel). Part III of the report describes the broad infrastructure of the ORGEL project mainly located at the Ispra establishment: the ECO critical experiment, the ESSOR reactor (the purpose of which is to test ORGEL channel assembly in typical conditions), and various installations. (auth)

40827 (EUR-1830.e(Pt.II)) EURATOM'S SCIENTIFIC ACTIVITIES. ORGEL PROGRAM—EXPERIMENTAL STUDIES. (European Atomic Energy Community). 1964. 705p.

40828 (EUR-1830.e(Pt.III)) EURATOM'S SCIENTIFIC ACTIVITIES. ORGEL PROGRAM—EXPERIMENTAL FACILITIES. (European Atomic Energy Community). 1964. 360p.

40829 (EURAEC-1175) RESEARCH PROGRAM FOR THE GARIGLIANO NUCLEAR POWER PLANT. Report No. 1. Quarterly Report No. 1 and 2. (Società Elettronucleare Nazionale, Rome). July 1, 1964. Work Performed under United States–Euratom Joint Research and Development Program. Contract 101-63-11-RDI. 19p.

Progress is reported on installation of computer equipment at the power plant; a GE 412 computer was ordered and programs are being written and collected. Preliminary results and test procedures for irradiation testing of pressure vessel steel (Ni–Cr–Mo) are discussed; Charpy V notch and tensile-test specimens were placed in stainless steel capsules for inclusion in the reactor and steam drum areas. (R.E.U.)

40830 (GA-4072) TARGET—A PROGRAM FOR A 1000-Mw(e) HIGH-TEMPERATURE GAS-COOLED REACTOR. Quarterly Progress Report for the Period Ending, February 28, 1963. (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Mar. 29, 1963. Contract AT(04-3)-167. 53p.

Activities in a preliminary design study are reported. The efforts at this stage are directed toward the design of an arrangement in which the entire primary system is contained in a single concrete pressure vessel. Progress is reported in steam-cycle studies, boiler design, mechanical design, coolant activity, shielding development, and helium venting systems. Other work is reported on advanced fuel development, turbocirculator development, alternate fuel-cycle development, and alternate materials of construction. (J.R.D.)

40831 (GA-4350) TARGET—A PROGRAM FOR A 1000-Mw(e) HIGH-TEMPERATURE GAS-COOLED REACTOR. Quarterly Progress Report for the Period Ending, May 31, 1963. (General Atomic Div., General Dynamics Corp., San Diego, Calif.). June 26, 1963. Contract AT (04-3)-167. 76p.

The reference design for the 1000-Mw(e) high-temperature gas-cooled reactor plant was further developed during the reporting period. Progress is reported on steam-cycle studies, boiler design, fission-product control, advanced fuel development, turbocirculator development, alternate fuel-cycle development, and development of alternate construction materials. (J.R.D.)

40832 (GA-5377) A CONCEPTUAL DESIGN OF A 1000-Mw(e) HTGR. R. M. Fryar (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Aug. 21, 1964. Contract AT(04-3)-167. 13p. (CONF-446-38)

From American Nuclear Society 10th Annual Meeting, Philadelphia, June 1964.

The feasibility and economic desirability of a 1000-Mw(e) high-temperature gas-cooled reactor are considered. The HTGR is a thermal-spectrum, vertical-flow, helium-cooled, graphite-moderated, pressure-vessel reactor operating on the U–Th cycle and producing superheated steam. Graphite serves as fuel cladding and moderator. (R.E.U.)

40833 (GN-37) STAZ-2—UN PROGRAMMA PER L'ANALISI TERMOIDRAULICA DI UN CANALE DEL NOCCIOLO DI UN REATTORE NUCLEARE, MODERATO E REFRIGERATO AD ACQUA, IN FUNZIONAMENTO STAZIONARIO. (STAZ-2—A Program for the Thermo-Hydraulic Analysis of a Channel of the Core of a Nuclear Reactor, Cooled and Moderated by Water, in Stationary Operation). A. Besi, V. Magri, G. Previti, and G. F. Antognetti (Italy. Comitato Nazionale per l'Energie Nucleare, Ispra). [1962]. 71p.

The code STAZ-2, programmed for IBM-704, was designed for the thermo-hydraulic analysis of a channel of the core of a reactor cooled and moderated with water during operation in the steady state. The code takes into consideration cores with a single passage and with sealed channels with fuel elements of the rod or plate type. The temperature distribution in the coolant and fuel, the distribution of density and vacuum, the loss of charge, and the DNB ratio (ratio between the critical thermal flux and effective thermal flux) were calculated with the code. (tr-auth)

40834 (HW-80253) PLUTONIUM RECYCLE TEST REACTOR POWER TEST RESULTS. V. W. Gustafson (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Dec. 1963. Contract AT(45-1)-1350. 54p.

The results of a number of performance tests conducted at the Plutonium Recycle Test Reactor (PRTR) to investigate the operating characteristics of the plutonium-fueled, D_2O-moderated reactor and to provide operational physics information are presented. Results of long-term reactivity changes, temperature coefficients of reactivity, photoneutron flux measurements, xenon transients, and kinetics measurements are included. The results show that satisfactory kinetic and control characteristics were achieved with the zone-enriched, plutonium-aluminum, UO_2 core operation. (auth)

40835 (IDO-28616) ARMY GAS-COOLED REACTOR SYSTEMS PROGRAM. IN-PILE TEST OF PROTOTYPE ML-1 FUEL ELEMENTS. J. S. Brunhouse, A. B. Burgess, G. T. Geering, S. Nakazato, and G. W. Titus (Aerojet-General Nucleonics, San Ramon, Calif.). June 1964. Contract AT(10-1)-880. 211p.

Prototype fuel elements of the design used in the first core loading of the ML-1 (mobile nuclear power plant) reactor were tested in-pile. The IB-8T-1 (instrumented) test element operated for 6415 hr in 99.5 wt % nitrogen with 0.5 wt % oxygen under ML-1 operating temperature conditions. Test data indicated that the fuel pin cladding temperatures were in excellent agreement with design calculations and that the element would operate at full power (55 kw) without exceeding the specified cladding hot spot temperature (1750°F). No change in pressure drop across the test element was observed during the test, indicating that the configuration of the assembly was not altered by the exposure. No evidence of cladding failure or other malfunction was observed. Post-irradiation examination of the IB-8T-1 test element revealed that the fuel pins were deformed by spiral bending; analysis indicated that this condition was the result of constraint imposed by the spacer wires during thermal growth of the fuel pins. Metallographic evaluation revealed a massive second phase in the cladding of certain fuel pins. After comprehensive investigation, this formation was attributed to exposure of the Hastelloy X cladding to pure nitrogen; the second phase was identified as a variant of the pi-phase with a lattice parameter of 6.35 to 6.40 Å. Examination indicated that the $BeO–UO_2$ and UO_2 fuel in the test element had performed satisfactorily. The IB-8T-2 (uninstrumented) test element operated for 6415 hr in oxygenated nitrogen plus 3736 hr in air for a total of 10,151 hr. Performance of the element during the test was completely satisfactory. Post-irradiation examination revealed excellent resistance of the Hastelloy X fuel pin cladding to oxidation by the gas, the maximum oxidation penetration observed was 0.0044 in. No evidence of the pi-phase was observed in the cladding; the structure and physical properties of the irradiated material closely resembled that of laboratory specimens exposed out-of-pile for similar periods at the same temperature. The IB-8T-2 test element, after removal from the test loop, appeared capable of operating for several thousand additional hours. (auth)

40836 (LADC-6264) COMPARISON OF CRAM AND DDK CODES IN THE CALCULATION OF CONTROL ROD WORTHS FOR UHTREX. R. J. LaBauve (Los Alamos Scientific Lab., N. Mex.). [1963]. Contract W-7405-eng-36. 5p. (CONF-446-23)

From American Nuclear Society 10th Annual Meeting, Philadelphia, June 1964.

CRAM, a multigroup diffusion code, and DDK, a multigroup S_n-transport code, were used in control rod calculations for the Ultra-High Temperature Reactor Experiment. Results are compared for the center, plug ring, and core ring regions and are found to be in fair agreement. It is planned to use CRAM in the study of the control system, with DDK being used for a few checkpoints. (D.L.C.)

40837 (LA-DC-6265) NUCLEAR CHARACTERISTICS OF SOME MOLTEN Pu-FUELED BREEDER SYSTEMS. W. H. Hannum (Los Alamos Scientific Lab., N. Mex.). [1963]. Contract W-7405-eng-36. 5p. (CONF-446-22)

From American Nuclear Society 10th Annual Meeting, Philadelphia, June 1964.

Specific powers and doubling times are discussed for various modular configurations of molten Pu-fueled drivers, each surrounded by blanket. The individual modules are subcritical unless coupled. The sodium-cooled Ta capsules contain the fuel (Pu–Co–Ce alloy). (R.E.U.)

40838 (NAA-SR-7785) EXPERIMENTAL TESTING OF CORE COMPONENT HANDLING EQUIPMENT AND HANDLING TECHNIQUES FOR HALLAM NUCLEAR POWER FACILITY. W. A. Kaspic (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Sept. 15, 1964. Contract AT(11-1)-Gen-8. 88p.

Satisfactory operation of the core component handling equipment and handling techniques for the Hallam Nuclear Power Facility was accomplished and confirmed by a program of testing. The test results indicated that the operational techniques were safe and that the equipment is dependable throughout its expected range of operations. (auth)

40839 (NAA-SR-7913) PREDICTED NUCLEAR CHARACTERISTICS OF THE HNPF FIRST CORE. M. P. Aronchick (Atomics International. Div. of North Ameri-

can Aviation, Inc., Canoga Park, Calif.). Aug. 1, 1964. Contract AT(11-1)-Gen-8. 51p.

The predicted nuclear characteristics of the Hallam Nuclear Power Facility (HNPF) first core, fueled with 140 elements composed of a U–10 wt % Mo alloy enriched to 3.6 wt % ^{235}U, are presented. The initial k_{eff} is predicted as 1.088, the control rod worth as 14.6% Δk, and the sodium worth as 4.8% Δk. The methods used to obtain these results are described and compared with experimental results from the HNPF Exponential Experiment. One- and two-dimensional power profiles are presented and discussed, and an overall power peak-to-average ratio of 2.78 is predicted. First-core burnup estimates and kinetics parameters are also presented. (auth)

40840 (NAA-SR-9488) STEAM CYCLE OPTIMIZATION STUDY FOR LARGE SODIUM GRAPHITE NUCLEAR POWER GENERATING STATIONS. G. A. Schneider (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Aug. 31, 1964. Contract AT(11-1)-Gen-8. 99p.

The general trend that is apparent from the optimization studies for SGR nuclear power plants are as follows: 1) For plant ratings up to approximately 350 Mw(e), 2400-psig steam pressure would be the most economical operating condition. 2) For plant ratings above 350 Mw(e), 3500-psig steam pressure is the economic selection. 3) The highest justifiable steam temperature for reheat cycles at 1150°F reactor outlet temperature is 1000/1000°F, the final selection being either 950/950°F or 1000/1000°F. 4) For all plant ratings studied, the best range for the value of the sodium temperature difference across the reactor is from 350 to 375°F. 5) The best range for the value of the temperature approach of the intermediate heat exchanger for the 2400-psig steam cycle is 65 to 80°F; while for the 3500-psig steam cycle, the range is 85 to 95°F. Decisions on the actual plant design steam conditions should be based on studies for a specific plant site and on specific utility company ground rules, not on generalized steam studies. (auth)

40841 (NAA-SR-9510) CORE II PHYSICS TESTS ON THE SODIUM REACTOR EXPERIMENT. M. R. Pellet (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Aug. 1, 1964. Contract AT(11-1)-Gen-8. 21p.

A series of experiments were performed during the operation of the SRE-Core II to determine some of the basic nuclear parameters for that core. The reactor transfer function for the second fuel loading was measured with a pile oscillator. Measurements at-power were first performed while the core had a positive prompt power coefficient. After the fuel clusters were constrained, the transfer function at 10, 15, and 20 Mwt clearly demonstrated the absence of a positive coefficient. The combined fuel temperature coefficient was found to be −12¢/°F by the flow ramp analysis. The inlet temperature coefficient was determined, by the use of an inlet temperature ramp, to be −0.23¢/°F. The xenon parameters previously determined were verified. The results of the shim rod No. 3 calibration check show that the present shim rod worth is 94% of that initially determined. The integrated isothermal temperature coefficient was found to be 72.7 cents as compared to 81.9 cents previously. (auth)

40842 (NAA-SR-9943) AIROS — A DIGITAL SIMULATOR FOR POWER REACTOR DYNAMICS. R. A. Blaine and R. F. Berland (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Aug. 1, 1964. Contract AT-11-1-GEN-8. 121p.

AIROS solves the space independent reactor kinetics equations and provides for the determination of reactivity by solving in addition the discretized equations that represent the spatial heat and mass transfer model for several fuel channels. In addition, variation of the film coefficient with flow is accounted for along with the provision for flow decay and afterglow heating. Scrams can be initiated by delayed signals from instruments that sense any quantity calculated, e.g., power, inverse period, or temperature. AIROS is built of small modules or subroutines so that future modifications or additions can be made as better physical models are available. An initial temperature calculation will be incorporated for use on an input option. This input generation routine is being written for optional use to compute the conduction and convection coefficients, for a n × m multichannel, nodal system with built-in tables of specific heat, density, conductivity, and viscosity for the common fuel, structure, and coolant materials. Similarly, other modifications can easily be made. Up to 100 feedback equations and 15 delayed neutron equations can be solved in addition to the prompt neutron equation. The numerical method is essentially a 5th-order method with automatic time-step variation to ensure the required accuracy with the minimum expenditure of computer time. Special provisions are made for startup problems resulting in 60% reduction in running time over conventional codes. Both printed and graphical output are provided at the user's option. Any 39 of the feedback variables can be printed and/or displayed. In addition, the grouping of feedbacks on each CRT frame is under the user's control. The program was written in FORTRAN II for IBM 7090/7094 with SC 4020 graphical display. (auth)

40843 (NAA-SR-Memo-9523) PERIOD SPIKES RELATED TO SRE OPERATING HISTORY. J. D. Perret, Jr. (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Mar. 27, 1964. Contract [AT(11-1)-Gen-8]. 21p.

Seventy-four period spikes were recorded during SRE Core II operation from October 8, 1962 to February 15, 1964. The occurence, frequency, and magnitude of these events as related to SRE operations are documented. The observations and reasoning, which support gas bubble passage through the core as the most probable cause, are presented. (auth)

40844 (NAA-SR-Memo-9605) HNPF OAP FUEL ELEMENT EXPOSURE AND REACTOR POWER DISTRIBUTION — ANALYTICAL METHOD. R. M. Mills (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Apr. 8, 1964. Contract [AT(11-1)-Gen-8]. 42p.

Individual fuel element exposure must be calculated from plant operating data to determine fuel element removal dates and to guide incore fuel shuffling. In addition the power distribution across the core, which is used to calculate the element exposure, can be used to observe current core behavior and changes in power distribution. The calculated values of relative power for each fuel channel are used to form a contour map that shows the peaks and valleys in the power distribution across the core. Since the above calculations and contouring are very time consuming and must be repeated at least once each month for successful monitoring of the core, a digital computer program was developed to perform the calculations and contouring is accomplished with the SC-4020 automatic display equipment. In addition the accumulated exposure of each fuel element can be contour-plotted as a visual aid to fuel management. Provision was made in the computer

program to permit the contouring of three other variables if desired such as peak power, peak temperature, or outlet temperature. Relative power for each element is a function of the relative coolant flow through the channel (determined from the orifice position) times ΔT from bottom to top of the channel. The fuel element exposure, Mwd/MTU, is a function of the relative power developed by the element, the integrated power of the reactor, the number of elements in the core, and the weight of uranium in the element. (auth)

40845 (NAA-SR-Memo-9639) OMRE CORE III COOLANT ANALYTICAL RESULTS. G. S. Adams, E. C. Mapes, and R. J. Sullivan (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Mar. 10, 1964. Contract [AT(11-1)-Gen-8]. 37p.

The OMRE coolant quality was determined on a daily basis by analyses for ash, pyrolytic capsule fouling test, Fe by x-ray-fluorescence, membrane stain test, gamma pulse height analysis, and high boiler by distillation. These analyses showed that the coolant impurities were considerably lower during Core III than had existed in Core I and II. The analyses also show that the impurities during Core III-B and C were lower than had existed in Core III-A. Average results are tabulated. (auth)

40846 (NAA-SR-Memo-9741) SRE-PEP TRANSIENT EXCURSION ANALYSIS. F. J. Halfen (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Mar. 30, 1964. Contract [AT(11-1)-Gen-8]. 35p.

An analysis has been made of the SRE Core III (PEP) configuration for the following incidents: uncontrolled rod withdrawal from shutdown; uncontrolled rod withdrawal from full power; and loss of main coolant flow at full power. The analysis shows that the mathematically postulated protective system will provide both primary and backup protection against excessively high temperatures resulting from the incidents studied. (auth)

40847 (NAA-SR-Memo-9829) PROGRAM FOR DETERMINING THERMO ELECTRIC SYSTEM WEIGHTS AND DESIGN POINTS. R. J. Mikell and G. T. Chang (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). June 18, 1964. Contract [AT(11-1)-Gen-8]. 17p.

The digital computer program performs calculations using all combinations of the input design parameters. The results of the total weight calculation are then examined for the minimum. (auth)

40848 (NP-9115(Pt.C)(Vol.I)) APPLICATION OF PHILADELPHIA ELECTRIC COMPANY FOR CONSTRUCTION PERMIT AND CLASS 104 LICENSE. PART C. FINAL HAZARDS SUMMARY REPORT— PEACH BOTTOM ATOMIC POWER STATION. VOLUME I. SITE AND ENVIRONMENTAL INFORMATION. (Philadelphia Electric Co.). [1963]. 257p. (DOCKET-50-171)

The Final Hazards Summary Report consists of five volumes; Volume I, Site and Environmental Information, contains information pertaining to the reactor site and surrounding area, including the results of detailed investigations of site characteristics and a discussion of analytical procedures developed to evaluate the environmental consequences of postulated accident situations. Volumes II, III, IV, and V, plant description and safeguard analysis, present the features of the design, construction, and operation of the nuclear power plant that are pertinent to its safety at the site, and include analyses of postulated accidents and their consequences. Figures associated with the text of Volumes II and III comprise Volume IV. Data supplementary to the information in Volumes II and III, but too detailed for inclusion in those volumes, is contained in Volume V. (auth)

40849 (NP-9115(Pt.C)(Vol.II)) APPLICATION OF PHILADELPHIA ELECTRIC COMPANY FOR CONSTRUCTION PERMIT AND CLASS 104 LICENSE. PART C. FINAL HAZARDS SUMMARY REPORT— PEACH BOTTOM ATOMIC POWER STATION. VOLUME II. PLANT DESCRIPTION AND SAFEGUARDS ANALYSIS (SECTIONS I AND II). (Philadelphia Electric Co.). [1963]. 343p. (DOCKET-50-171)

40850 (NP-9115(Pt.C)(Vol.III)) APPLICATION OF PHILADELPHIA ELECTRIC COMPANY FOR CONSTRUCTION PERMIT AND CLASS 104 LICENSE. PART C. FINAL HAZARDS SUMMARY REPORT— PEACH BOTTOM ATOMIC POWER STATION. VOLUME III. PLANT DESCRIPTION AND SAFEGUARDS ANALYSIS (SECTIONS III THROUGH VII). (Philadelphia Electric Co.). [1963]. (DOCKET-50-171)

40851 (NP-9115(Pt.C)(Vol.IV)) APPLICATION OF PHILADELPHIA ELECTRIC COMPANY FOR CONSTRUCTION PERMIT AND CLASS 104 LICENSE. PART C. FINAL HAZARDS SUMMARY REPORT— PEACH BOTTOM ATOMIC POWER STATION. VOLUME IV. PLANT DESCRIPTION AND SAFEGUARDS ANALYSIS (FIGURES). (Philadelphia Electric Co.). [1963]. 271p. (DOCKET-50-171)

40852 (NP-9115(Pt.C)(Vol.V)) APPLICATION OF PHILADELPHIA ELECTRIC COMPANY FOR CONSTRUCTION PERMIT AND CLASS 104 LICENSE. PART C. FINAL HAZARDS SUMMARY REPORT— PEACH BOTTOM ATOMIC POWER STATION. VOLUME V. PLANT DESCRIPTION AND SAFEGUARDS ANALYSIS (ANNEXES). (Philadelphia Electric Co.). [1963]. 273p. (DOCKET-50-171)

40853 (NP-14250) REPORT ON THE 17-4 PH STAINLESS STEEL COMPONENTS FOR THE CONSOLIDATED EDISON CONTROL ROD DRIVE ASSEMBLIES. (Babcock and Wilcox Co. Atomic Energy Div., Lynchburg, Va.). Sept. 10, 1961. For Consolidated Edison Co. of New York, Inc. 219p. (DOCKET-50-3)

The 900°-aged 17-4 PH stainless steel components which operate in the primary coolant were replaced with components fabricated from 17-4 PH material which was aged at 1100°. Results are reported of the program of fabrication development, inspection, and tests. The components included the buffer seal shafts, snubber shafts, and miscellaneous parts (buffer seal spacer rings, snubber spring washers, etc.). (D.L.C.)

40854 (NP-14252) HAZARDS ANALYSIS BY THE DIVISION OF LICENSING AND REGULATION IN THE MATTER OF ALLIS-CHALMERS MANUFACTURING COMPANY— DAIRYLAND POWER COOPERATIVE LA CROSSE BOILING WATER REACTOR CONSTRUCTION AUTHORIZATION. Edson G. Case (Division of Licensing and Regulation, AEC). Jan. 4, 1963. 30p. (DOCKET-115-5)

A provisional construction authorization is to be issued to Allis-Chalmers for the LaCrosse Boiling Water Reactor. The basis for the recommendation of this authorization, a hazards analysis by the Division of Licensing and Regulation, is presented. Among the items discussed are the reactor site, containment, core, power equipment, control and safety systems, monitoring, waste disposal, etc. The research and development program for the reactor is

outlined. Future considerations to be taken in the final hazards summary report are given. The accident analyses by Allis-Chalmers are discussed. The technical qualifications of Allis-Chalmers are considered, and recommendations are given on the issuance of technical reports and the design of the control rod drive system. (D.L.C.)

40855 (NP-14253) CONSOLIDATED EDISON THORIUM REACTOR OVERALL CONTROL SYSTEM CHARACTERISTICS AND FLOW COEFFICIENT OF REACTIVITY TEST RESULTS. July 3, 1963. 21p. (DOCKET-50-3)

The plant controller constants were established, and the flow coefficient of reactivity was measured. Favorable results were obtained. (R.E.U.)

40856 (NP-14270) TEST OPERATION OF THE DRESDEN REACTOR AT ATMOSPHERIC PRESSURE WITH THE REACTOR VESSEL HEAD REMOVED. Report No. 2. (Commonwealth Edison Co., Chicago and General Electric Co. Atomic Power Equipment Dept., [Schenectady, N. Y.]). Apr. 15, 1960. 12p. (DOCKET-50-10)

See GEAP-1044 for main hazards report.

The operations described were performed during reactor loading and critical testing. It is noted that the results agree well with design predictions and calculations. A summary of control rod operational experience is included. (J.R.D.)

40857 (NP-14271) TEST OPERATION OF THE DRESDEN REACTOR AT POWER LEVEL TO 315 MW. Report No. 3. (Commonwealth Edison Co., Chicago and General Electric Co. Atomic Power Equipment Dept., [Schenectady, N. Y.]). Apr. 27, 1960. 22p. (DOCKET-50-10)

See GEAP-1044 for main hazards report.

A description of the test operation is presented. It is noted that the system performed well and essentially as results of analytical studies indicated. (J.R.D.)

40858 (NP-14272) FUEL ELEMENT REPORT — ELK RIVER REACTOR. (Allis-Chalmers Mfg. Co. Nuclear Power Dept., Washington, D. C.). Sept. 16, 1960. 52p. (DOCKET-115-1)

The fuel element development program for the Elk River Power Reactor is outlined. The fabrication and boron-content analysis of SS 304 fuel tubes, hydraulic stability of the core configuration, design specifications for the fuel elements, manufacture of the ThO_2–UO_2 sintered fuel, fabrication of miscellaneous castings of austenitic steel, fabrication of end plugs for the fuel rods, and fabrication of the SS fuel rod tubes containing burnable boron poison are discussed. (R.E.U.)

40859 (NP-14274) PRESENTATION TO AEC AND ACRS OF AN IMPROVED CONTROL ROD ABSORBER DESIGN FOR PWRS. [Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh]. June 5, 1963. 21p. (DOCKET-50-213)

The design and testing of a control rod absorber configuration to replace the "standard" cruciform control element (absorber and follower) is discussed. The Rod Cluster Control system is to be situated within the fuel element and is of comparable dimensions and configuration. Each control element consists of a cluster of cylindrical absorber rods connected at the top and coupled to a drive mechanism. Because of uniform spacing in the lattice, the control rods do not require followers. (R.E.U.)

40860 (NP-14275) STATUS REPORT ON THE PEACH BOTTOM HIGH TEMPERATURE GAS-COOLED REACTOR. J. L. Allen (Philadelphia Electric Co.); M. R. Born, and G. R. Hopkins (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Mar. 26, 1964. 15p. (DOCKET-50-171)

The 40-Mw(e) prototype HTGR at Peach Bottom, Penn., is being constructed and should be completed before the end of 1964. The research program to be carried out during the reactor operation is described briefly. A general description of the plant is given, and its design characteristics are tabulated. (D.L.C.)

40861 (NP-14277) DRESDEN NUCLEAR POWER STATION — SUMMARY OF DYNAMIC STRESS ANALYSIS OF CORE SUPPORT GRID. T. F. Robinson (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). May 17, 1962. 14p. (DOCKET-50-10)

Static and dynamic loads were applied and analyzed using the equivalent beam method. A static loading was also analyzed on a structural computer program. The natural frequency of the full and half beam structures was calculated. It was found that the full beam structure with cracks present is good for 10,000 cycles or 5,000 turbine trips. Inspection of the Dresden core support structure is discussed briefly. (D.L.C.)

40862 (NP-14278) DRESDEN NUCLEAR POWER STATION. LOW-LEVEL TESTING AND RECONSTITUTION OF THE OPERATIONAL CORE. (Commonwealth Edison Co., Chicago and General Electric Co. Atomic Power Equipment Dept., [Schenectady, N. Y.]). Feb. 28, 1961. 6p. (DOCKET-50-10)

See GEAP-1044 for main hazards report.

Plans for critical-assembly-type tests to be run at atmospheric pressure with the reactor vessel head removed are described. One series of tests involves the loading of reload-type fuel clad with stainless steel and not previously reactor-exposed, and another series involves the loading to and testing in the minimum critical configuration using fuel assemblies that were centrally located in the core during previous power operation of the Dresden Reactor. (J.R.D.)

40863 (NP-14279) DRESDEN NUCLEAR POWER STATION. CONTROL BLADE REVISIONS. (Commonwealth Edison Co., Chicago and General Electric Co. Atomic Power Equipment Dept., [Schenectady, N. Y.]). Feb. 27, 1961. 13p. (DOCKET-50-10)

See GEAP-1044 for main hazards report.

Information is presented for use in evaluation of an alternate control blade design to replace the currently designed blades. (J.R.D.)

40864 (NP-14280) DRESDEN NUCLEAR POWER STATION ADDITIONAL INFORMATION ON PROPOSED IMPROVEMENTS TO THE LIQUID POISON SYSTEM. (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). Oct. 15, 1961. 13p. (DOCKET-50-10)

Answers are given to AEC questions regarding the proposed changes to the liquid poison system. They cover operability, redesign, and functional testing during normal plant operation. Specifications and drawings are given for the liquid poison tank, pump, liquid level switch, and poison injector valve. (D.L.C.)

40865 (NP-14286) ANNUAL REPORT ON VBWR OPERATIONS. (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). Apr. 17, 1961. 10p. (DOCKET-50-18)

The operation of the Vallecitos Boiling Water Reactor from February 1, 1960 to January 31, 1961, is summarized. (N.W.R.)

40866 (NP-14287) DRESDEN NUCLEAR POWER STATION ANNUAL REPORT OF STATION OPERATION FOR THE YEAR 1963. (Commonwealth Edison Co., Chicago). Jan. 17, 1964. 55p. (DOCKET-50-10)

The operation of the Dresden Power Reactor during 1963 is described. (N.W.R.)

40867 (NYO-10537) SPECIFICATION FOR PM-TYPE NUCLEAR REACTOR CORES. (TYPE 2 DESIGN). D. E. Goslee (Hittman Associates, Inc., Baltimore). Apr. 22, 1963. Contract AT(30-1)-3131. 145p.

Materials, components, assembly, inspection, testing, quality control, and delivery requirements for type 2 replacement cores for the PM-1 and PM-3A reactors are discussed. The tubular fuel elements are enriched UO_2 dispersed in a stainless steel matrix and clad in wrought stainless steel. The burnable poison elements are rods containing natural boron carbide particles dispersed in a Zircaloy-2 matrix and clad with stainless steel. The control rod is a Y-shaped assembly of three flat plates, each containing a dispersion of ($Eu_2O_3 \cdot 2TiO_2$) in a matrix, frame, and cladding of stainless steel. Complete specifications are given. (R.E.U.)

40868 (NYO-10538) SPECIFICATION FOR SM-1A TYPE NUCLEAR REACTOR CORES. (TYPE 3 DESIGN). D. E. Goslee (Hittman Associates, Inc., Baltimore). Sept. 1, 1963. Contract AT(30-1)-3131. 104p.

The materials, components, assembly, inspection, testing, quality control, and delivery requirements for Core III replacement assemblies for SM-1A reactor are discussed. The fuel assemblies consist of plates with fuel cores of enriched UO_2 and ZrB_2 dispersed in a stainless steel matrix and suppressor cores of Eu_2O_3 dispersed in a stainless steel matrix. Complete specifications are given. (R.E.U.)

40869 (ORNL-3584) A POTASSIUM–STEAM BINARY VAPOR CYCLE FOR NUCLEAR POWER PLANTS. W. R. Chambers, A. P. Fraas, and M. N. Ozisik (Oak Ridge National Lab., Tenn.). May 1964. Contract W-7405-eng-26. 52p.

The basic factors limiting the efficiency of both conventional steam power plants and mercury-vapor and steam binary cycle plants are discussed relative to the potential of a potassium-vapor and steam cycle for nuclear power plant applications. A conceptual design for one embodiment of the latter coupled to a molten-salt reactor is described. Its thermal efficiency is estimated to be 54%, and the associated calculations, including those for the size of the principal components, are appended. The quantities of material required for the heat exchangers and piping for both a coal-fired supercritical-pressure steam plant and a nuclear-powered potassium vapor and supercritical-steam plant are estimated along with the associated costs. The resulting cost and performance data indicate that the nuclear plant with a potassium-vapor and steam binary cycle could give both lower capital charges and a much higher overall efficiency than a coal-fired supercritical-pressure steam plant. (auth)

40870 (SL-2155) ENGINEERING STUDIES—HEAVY WATER MODERATED POWER REACTOR PLANTS. (Sargent and Lundy, Chicago). June 30, 1964. Contract AT (38-1)-213. 83p.

A complete conceptual design and cost estimate for a 300-Mw(e) D_2O-moderated and -cooled prototype power reactor plant was prepared. DuPont developed the design and costs for the reactor, primary coolant system, reactor auxiliaries, fuel handling system, and the reactor and fuel service building. Sargent & Lundy was responsible for the design and cost estimate for the turbine-generator plant, circulating water system and structures, radioactive waste disposal system, plant services and utilities, and site development work. A description of the entire plant and its associated costs is given in DuPont Report DP-910. This report describes only the work done by Sargent & Lundy. Approximately 4,177,000 lbs/hr of 570 psia dry and saturated steam are used in the turbine plant to generate a gross electrical power of 320 Mw(e) when the condenser pressure is at 1.5 in. HgA. At these conditions the gross cycle efficiency is 31.7%. The turbine-generator is a TCDF-43" LSB unit nominally rated at 300,000 kw. A single split-box condenser is used to condense the steam at the turbine exhaust and two one-half capacity motor driven condensate and feed-water pumps serve to return feed water to the reactor plant. Five stages of regenerative feed water heating, including a deaerator, are used to heat the final feed water to a temperature of 402°F. (auth)

40871 (TID-8214) OPERATING HISTORY OF U. S. NUCLEAR POWER REACTORS. (Division of Reactor Development, AEC). [1963]. 38p.

The operating histories of several U. S. power reactors are summarized; included are facilities that produce or have produced electricity, even if in token amounts. Charts show cumulative thermal energy as a function of time. Shutdowns of less than 5 days are not included. Information on reactor availability and plant capacity factor are given for civilian facilities. (R.E.U.)

40872 (TID-21059) TECHNICAL SPECIFICATIONS FOR THE RCPA ELK RIVER REACTOR AT ELK RIVER, MINNESOTA. (Allis-Chalmers Mfg. Co. Atomic Energy Div., Washington, D. C.). Revised Sept. 1, 1961. Contract AT(11-1)-654. 47p. (DOCKET-115-1)

Specifications for the Elk River Power Reactor and plant facilities are given. The plant utilizes a 58.2 Mw(t) light boiling water reactor with a 14.5 Mw(t) conventional superheater. (R.E.U.)

40873 (TID-21073) GARIGLIANO NUCLEAR POWER PLANT. Technical Report, June 30, 1964. (Società Elettronucleare Nazionale, Rome). 18p.

The Garigliano Nuclear Power Plant practically entered commercial operation. The power tests were completed except for the official 100-hour acceptance test. The research program for the reactor is discussed. The problem of turbine overspeed is analyzed, and operation performance is evaluated. (N.W.R.)

40874 (TID-21085) DIVISION OF LICENSING AND REGULATION REPORT TO ADVISORY COMMITTEE ON REACTOR SAFEGUARDS ON PACIFIC ELECTRIC AND GAS COMPANY. (Division of Licensing and Regulation, AEC). Aug. 24, 1959. 11p. (DOCKET-50-133)

A general description of the proposed reactor (boiling water, 163 Mw(t), 50 Mw(e), UO_2–fueled) is given. A brief analysis of the proposed reactor site near Eureka, California, is given. (R.E.U.)

40875 (WAPD-PWR-TE-145) RADIATION BUILDUP ON MECHANISMS AND THERMAL BARRIERS. E. Weingart (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). June 1963. Contract AT-11-1-GEN-14. 27p.

Control rod mechanism components and the thermal barriers, which interpose between the reactor vessel head and the mechanisms, were determined after Seed 1 and Seed 2 to have been a major source of reactor head activity levels, as a result of crud buildup. The evaluation is concerned with the deposits on the mechanisms and ther-

mal barriers that accumulated during Seed 3, as determined by surveys of components removed during refueling. The purpose of this examination is to provide information on the accumulation of long-lived corrosion products and the mechanics of this deposition and transport in the head area. (auth)

40876 (WAPD-PWR-TE-164) SHIPPINGPORT PWR-1 SEED 4—DYNAMIC MEASUREMENT OF XENON FREE TEMPERATURE COEFFICIENT OF REACTIVITY. Test Evaluation. J. A. Crawford (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Mar. 25, 1964. Contract AT-11-1-GEN-14. 13p.

The xenon-free temperature coefficient of reactivity was measured continuously during reactor heatup. The results using this dynamic method of measurement agree within experimental error with the results of the static method of measurement. It was concluded that the dynamic measurement can be performed in a shorter time than the static measurement, but data analysis of the dynamic test results is much more difficult and time consuming than it is for the static method. (auth)

40877 (WO-2161-01) FEASIBILITY STUDY OF NUCLEAR POWER FOR DISASTER CONTROL AND CONSTRUCTION BATTALION OPERATIONS. BEACHHEAD PLANT. (Burns and Roe, Inc., New York). July 8, 1963. Contract NBy-45824. 190p. (AD-437832)

Results of a study on the feasibility of nuclear power plant application to beachhead operations by the military are presented. The object of the study is to provide a general plant description, an assessment of the feasibility of the application, a cost estimate, recommendations on power generation methods, and technical plant requirements. (auth)

40878 DESIGN OF NUCLEAR POWER PLANTS WITH GAS TURBINES. K. Bammert (Technische Hochschule, Hanover) and E. Boehm. Atomkernenergie, 9: 231-40 (July-Aug. 1964). (In German)

The heat generated in gas-cooled reactors can be used either for the generation of steam to drive a steam turbine or it can be used directly on a closed-cycle gas turbine. In the latter case the driving medium of the gas turbine is simultaneously the cooling medium for the reactor. Special conditions must therefore be satisfied, and these are fulfilled by helium. The contamination of the cooling medium by released fission products must also be low. Gaseous or volatile isotopes of high radioactivity must be prevented from entering into the turbine circuit. Therefore special safety requirements were derived for the single cycle system. Gas turbines that are expected to function with high economy must be combined with a high-temperature reactor. A beryllium oxide-moderated reactor with canned fuel elements satisfies these conditions. The design of such a reactor for 75 Mw leads to a core arrangement of high power density and thus makes possible a compact arrangement. The operation of a gas turbine with a working gas of such low density as is helium leads to enthalpy differences per unit mass that are four to five times those at the usual air turbines. However, it is shown that machines that are only slightly larger than the turbomachines of corresponding air turbines can be used. The heat exchanger and the coolers, due to the good thermal properties of helium, are smaller than in the case of closed cycle air turbine plants. (auth)

40879 ESTIMATION OF RADIOLOGICAL EFFECTS OF DISTURBANCES OF LARGE WATER COOLED POWER REACTORS. [PART] I. H. Karwat (Technische Hochschule, Munich). Atompraxis, 10: 341-5(Aug. 1964). (In German)

An evaluation was made to determine the influence of some parameters in the estimation of fission product contamination in the surroundings of a reactor station. The method used to determine the fission product release from a core that is heated due to a loss of coolant accident is described. Assuming a stepwise change in heat transfer at the fuel element surface at the beginning of the accident the non-steady state temperature behavior in the fuel rods was calculated, and the time delay between the start of the loss of coolant accident and bursting of the fuel clad was determined. Using a radial and axial partition of the whole core, the temperature rise in the core up to the melting temperature of uranium dioxide was calculated. An example showing the influence of the different release parameters was also calculated. (auth)

40880 PROGRAMME FOR THE E.d.F. NUCLEAR POWER STATIONS. D. Olivier-Martin. Econ. Elec., 38: 3-4(Jan.-Mar. 1964). (In French)

The future program for building and operating nuclear power stations is outlined, and outputs of the EDF reactors are indicated. (UKAEA)

40881 SITING DICTATES PLANT DESIGN CRITERIA. R. A. Wiesemann (Westinghouse Electric Corp., Pittsburgh). Elec. World, 161: No. 20, 101-4(May 18, 1964).

The effects of techniques for limiting exposure of the public to radiation during routine and accident conditions on the required isolation of the nuclear power plant are discussed. Containment, shielding, cooling system design, and fission product control are considered. (D.C.W.)

40882 ECONOMY HINGES ON MALIBU SITE. E. Koffmann (Dept. of Water and Power, Los Angeles). Elec. World, 161: No. 20, 107-9(May 18, 1964).

The advantages of a nuclear plant over a gas-fueled plant in terms of reduced air pollution and costs are indicated; and the site selected for the plant is described, together with the multiple containment planned for the pressurized water reactor. (D.C.W.)

40883 9TH NUCLEAR REPORT [GENERAL TECHNICAL AND ECONOMIC DATA FOR POWER REACTORS]. Elec. World, 161: No. 20, 114-22(May 18, 1964).

The general features, capital and operating costs, efficiency, and fuel utilization of nuclear power plants in design, construction, and operation are tabulated, where available. (D.C.W.)

40884 PWR PLANT HAS CONVENTIONAL CONTROLS. R. Eastman and D. F. Winters (Westinghouse Electric Corp., Pittsburgh). Elec. World, 161: No. 22, 49-51; 145(June 1, 1964).

The design and operation of the control system of a pressurized-water-reactor power plant are discussed, and the operational limits on such plants are considered. The similarity, apart from flux instrumentation, to the control system of conventional plants is noted. (D.C.W.)

40885 ITERATIVE ANALOG MODELS FOR THE DYNAMIC STUDY OF THE NUCLEAR POWER REACTOR CORES. A. Mathis and G. Valli (CNEN, Rome). Energia Nucl. (Milan), 11: 353-62(July 1964). (In Italian)

The dynamic behavior of a liquid fluid moderated and cooled reactor was simulated on the analog computer for studying the transients due to loss of flow and uncontrolled insertion of reactivity, during which local boiling of the coolant may happen. The analog model, which is of the iterative type, is formed by an average channel which

provides the feedbacks to the nuclear block, and by a section of the hot channel which gives, according to an assigned axial distribution of neutron flux, the local values of the coolant temperature of the thermal and critical burnout flux of the temperatures in the can and at the fuel central point. (auth)

40886 DETECTION OF CAN BREAKAGE IN NATURAL URANIUM GRAPHITE-GAS POWER REACTORS. Paul A. Gaillard. Energie Nucl., 6: 206-10(June 1964). (In French)

Can breakage, which limits the utilization of fuel, is closely related to reactor economy. The frequency of the phenomenon being unforseeable, it is necessary to control permanently the fuel elements. The general lines of the problem, the detection principle, are exposed. (auth)

40887 THE ORGEL PROJECT. J.-C. Leny and S. Orlowski (EURATOM-CCR, Ispra, Italy). Energie Nucl., 6: 211-24(June 1964). (In French)

The Orgel Project is the study of a system of reactors which are moderated with heavy water and cooled by an organic liquid (a mixture of polyphenyls). The Orgel Program first began to improve the knowledge of the materials to be used: organic coolants, structural materials, and to develop a uranium carbide fuel; thus allowing the development of a simple and cheap element. In addition, a reference project of a 250 Mw(e) station was designed. The raising of the coolant temperatures and, still better, the enrichment, offer interesting improvements for the future from the investment point of view. The work of the Orgel Project is being carried out at the Ispra establishment and uses the Eco critical experiment which is designed to study the neutronics of the Orgel-lattice in particular and of heavy water lattices in general, and the Essor reactor which is designed to test the Orgel channel under representative conditions. (auth)

40888 THE DRAGON PROJECT. VI. CARBON TRANSPORT. L. J. Valette. Ingenieur (Utrecht), 75: No. 11, 39-49(1963). (EUR 516.e).

The problem of carbon transport is defined as the combined removal of graphite from the hot core of the reactor and the back deposition of carbon on metallic components at lower temperature. The carbon transport is the result of temperature reversible reactions that occur between reactor materials and the impurities present in the coolant helium. A brief survey was made of the important variables affecting the carbon transport process; oxidation, carbon deposition, purification, in leakage, and outgassing of gaseous impurities. Based on the information available in literature it is shown that the extent of oxidation of graphite is governed by three single processes, the chemical reaction rate, the diffusion of the impurities in the graphite pores, and diffusion of the impurities from the main coolant to the graphite surface. Each of these processes becomes preponderant in different temperature ranges. Some aspects of the corrosion of Dragon fuel element components are discussed. Due to the temperature dependence of the reaction it is shown that corrosion along the fuel rod will be unevenly distributed and due to the high coolant flow, the depletion of impurities along these rods is negligible. On the other hand, in the purge channel the rate of depletion of impurities is much more pronounced, due to the small flow and the high graphite temperature. The calculations show that the top fuel boxes will be very severely damaged on a short distance. Finally, in order to prevent this last danger it is proposed to insert a getter for the impurities in the inlet purge flow. (auth)

40889 THE PROMISE OF NUCLEAR POWER. K. Fuchs (Zentralinstitut für Kernforschung, Rossendorf, Ger.). Kernenergie, 7: 365-8(June-July 1964).

The possibilities for satisfying the anticipated demand of the entire world for electrical energy by the year 2000 are discussed and the necessary conditions for realizing this demand with the aid of nuclear energy are described. Thermal reactors without plutonium re-cycling can satisfy a fraction of the total demand and fast reactors offer a long-range solution to the problem. Thermal reactors with plutonium re-cycling may play a part. The initial stock of plutonium required for an extended system of nuclear power stations employing fast reactors can be produced by thermal reactors. (auth)

40890 POWER REACTORS IN THE FEDERAL REPUBLIC OF GERMANY. W. Jacob and J. Ritterhoff (Technische Hochschule, Hanover and Universitat, Hamburg). Kerntechnik, 6: 301-3(July-Aug. 1964). (In German)

The various power reactors in operation, under construction, or seriously projected in the Federal Republic of Germany are listed and compared. (M.C.G.)

40891 THE GRAPHITE-MODERATED GAS-COOLED HIGH TEMPERATURE REACTOR (HTGR). H. Voelcker (Gutehoffnungshutte Sterkrade AG, Oberhausen-Sterkrade, Ger.). Kerntechnik, 6: 312-15(July-Aug. 1964). (In German)

The main characteristics of graphite-moderated, helium-cooled, high-temperature reactors of the HTGR type with ceramic fuel rods are given. The fuel element concept is explained. The nuclear design of the reactor system is discussed, and the prototype plant is described . The characteristics of large HTGR plants are given. (auth)

40892 ENGINEERING PROBLEMS IN THE DEVELOPMENT OF A FAST BREEDER AND POWER REACTOR. D. Smidt (Kernforschungszentrum, Karlsruhe, Ger.). Kerntechnik, 6: 316-24(July-Aug. 1964). (In German)

Some engineering problems of the fast breeder project of the Karlsruhe Nuclear Research Center are discussed, particularly economic aspects. The development of fuel and canning materials is emphasized, together with the associated irradiation experiments. Core design problems and the development of the pressure vessel, heat exchangers and pumps are discussed, together with the use of gaseous coolants rather than the sodium coolant under consideration. (D.C.W.)

40893 QUALITY AND PRECISION IN POWER REACTOR CONSTRUCTION. A. Setzwein. Kerntechnik, 6: 343-6(July-Aug. 1964). (In German)

The special requirements on quality and precision in power reactor construction are explained, and means for meeting the requirements are outlined. (D.C.W.)

40894 CONSTRUCTION OF JPDR. Yutaka Hirata. Nippon Genshiryoku Gakkaishi, 6: 306-11(June 1964). (In Japanese)

The design and construction of natural-circulation, direct-cycle, boiling-water (Japan Power Demonstration) reactor are briefly discussed. (D.C.W.)

40895 OPERATION OF JPDR. Yoshio Takada. Nippon Genshiryoku Gakkaishi, 6: 311-315(June 1964). (In Japanese)

Operational experience with the Japan Power Demonstration reactor is reviewed, including sequences of plant startup, shutdown, and scram recovery. Difficulties with water treatment are indicated. (D.C.W.)

40896 JPDR START UP TEST. Keiichi Mochizuki. Nippon Genshiryoku Gakkaishi, 6: 316-23(June 1964). (In Japanese)

Startup testing of the Japan Power Demonstration Reactor is summarized, including physics studies at zero power and calibration, control, and performance studies at power. (D.C.W.)

40897 RADIATION CONTROL IN JPDR. Kosaburo Nomura. Nippon Genshiryoku Gakkaishi, 6: 323-5(June 1964). (In Japanese)

Health physics activities at the Japan Power Demonstration Reactor are summarized. Radiation surveys at 150 points during power operation revealed radiation levels generally below expectations. (D.C.W.)

40898 CONSTRUCTION OF TOKAI ATOMIC POWER STATION. Susumu Tsujimoto. Nippon Genshiryoku Gakkaishi, 6: 326-30(June 1964). (In Japanese)

The 166-Mwe station under construction at Tokai-mura incorporates a gas (CO_2)-cooled, graphite-moderated reactor using hollow fuel elements of natural uranium. The facility is briefly described. (D.C.W.)

40899 CURRENT PROBLEMS ON POWER REACTOR FUELS. Ryuzo Ueda. Nippon Genshiryoku Gakkaishi, 6: 331-4(June 1964). (In Japanese)

Current problems with fuel materials, cladding materials, and fuel element designs for proven power reactor types are described; and nonmetallic fuels for future power reactors are discussed, including UC, UN, and UO_2. (D.C.W.)

40900 SAFETY OF POWER REACTOR. Tesuro Itakura. Nippon Genshiryoku Gakkaishi, 6: 334-8(June 1964). (In Japanese)

A brief review on reactor safety is presented, covering the views of the UKAEA and the USAEC as well as the main safety devices on existing power reactors. Boiling- and pressurized-water reactors particularly are considered. (D.C.W.)

40901 ECONOMIC ASPECTS OF NUCLEAR POWER. Seiichi Wakisaka. Nippon Genshiryoku Gakkaishi, 6: 339-54(June 1964). (In Japanese)

Prospects for reductions in nuclear power costs are discussed. Recent cost trends are also shown using published construction and power costs of large-scale power reactors under operation, construction, and consideration both in the United States and in the United Kingdom. Finally, several problems in evaluating nuclear power costs in Japan are discussed. (auth)

40902 PROGRAM FOR DEVELOPING JAPANESE HEAVY WATER POWER REACTOR. Eiichi Takeda. Nippon Genshiryoku Gakkaishi, 6: 346-50(June 1964). (In Japanese)

The Japanese program for heavy-water reactor development is outlined, together with initial efforts in the field. The bases for the selection of heavy-water reactors are given, and the selection of a coolant system is discussed. (D.C.W.)

40903 RESEARCH AND DEVELOPMENT OF THE JPDR-II. A FORCED CIRCULATION, HIGH POWER DENSITY BOILING WATER REACTOR. Junichi Miida and Keiichi Mochizuki. Nippon Genshiryoku Gakkaishi, 6: 350-5(June 1964). (In Japanese)

A research and development project for the proposed JPDR-II is described. The high power density of a boiling-water reactor is primarily being investigated using a forced-circulation system (a modified version of the present JPDR). High-power-density fuel design, physics calculations, heat transfer, fluid and flow and stability, and computer scheduling of the control are described. (auth)

40904 PROGRAMS OF COMMERCIAL NUCLEAR POWER DEVELOPMENT. Nippon Genshiryoku Gakkaishi, 6: 363-8(June 1964). (In Japanese)

The nuclear power development programs of four electric power companies in Japan are described. (auth)

40905 BOOM, SLOW-DOWN, THEN DRY AGE. PRESENT STATUS OF NUCLEAR POWER. Kazuhisa Mori. Nippon Genshiryoku Gakkaishi, 6: 369-71(June 1964). (In Japanese)

Recent world developments in nuclear power are outlined, with a brief consideration of the prospects. (D.C.W.)

40906 EVOLUTION OF THE CNSG III FROM 'SAVANNAH.' Nucl. Eng., 9: 280-3(Aug. 1964).

The evolution of the Consolidated Nuclear Steam Generator III (CNSG III) via the N.S. Savannah power plant, CNSG I, and CNSG II is described. The pressure vessel, control systems, core containment, and performance of CNSG III are outlined. (T.F.H.)

40907 CANDU—DOUGLAS POINT NUCLEAR POWER STATION. Nucl. Eng., 9: 289-94(Aug. 1964).

The characteristics of CANDU are tabulated, and the reactor systems are shown schematically. Descriptions are presented of the calandria, shields, pressure tubes, fuel elements, moderator, coolants and cooling systems, turbine, fuel handling systems, control systems, containment means, auxiliary systems, waste disposal means, and costs. A computer used with the reactor is also described. (T.F.H.)

40908 DEVELOPMENT AND UTILIZATION OF PYROLYTIC-CARBON-COATED CARBIDE FUEL FOR THE HIGH-TEMPERATURE GAS-COOLED REACTOR. Walter V. Goeddel (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Nucl. Sci. Eng., 20: 201-18(Oct. 1964). (GA-4699)

A brief review is presented of the development and evaluation of coated-particle fuel for the Peach Bottom high-temperature gas-cooled reactor. The results of extensive thermal and irradiation tests on the Peach Bottom fuel materials have shown them to be adequate for a 3-yr core life of this reactor. Consideration of the mechanisms that could lead to coating failure under irradiation has shown that swelling of the carbide particle from fission-product accumulation and shrinkage of the pyrolytic-carbon coating from fast-neutron and fission-recoil effects are the principal contributors to coating failure. A Triplex pyrolytic-carbon coating was developed to overcome these effects. This coating consists of a spongy layer of pyrolytic carbon overcoated with successive layers of laminar and columnar pyrolytic carbon. (auth)

40909 OPERATING HALLAM. Karl K. Brown, ed. Nucleonics, 22: No. 9, 41; 44-6(Sept. 1964).

The 81-Mwe, sodium–graphite reactor power station produces superheated steam at 860°F and 825 psig. The facility is briefly described, and its performance since initial commerical operation in October 1963 is summarized. Failures of moderater elements and orifice drive assemblies are discussed, as well as difficulties with the intermediate heat exchangers, sodium pumps, control rod thimbles, and steam generators in preliminary operation. (D.C.W.)

40910 D_2O REACTORS FOR BREEDING WITH THORIUM. D. S. St. John and J. W. Wade (E. I. du Pont de Nemours & Co., Aiken, S. C.). Nucleonics, 22: No. 9, 54-7(Sept. 1964). (TID-19409)

The advantages of heavy-water reactors operating as thorium breeders in terms of efficient utilization of uranium resources are indicated, with consideration of neutron balance, reactor design and technology, fuel and power costs, and initial fuel cycles. (D.C.W.)

40911 POWER REACTOR TECHNOLOGY. Volume 7, Number 2. Walter H. Zinn and J. R. Dietrich (General Nuclear Engineering Corp., Dunedin, Fla.). Spring 1964. $0.70(GPO) (Domestic), $0.90(GPO) (Foreign). (One of the Technical Progress Reviews prepared quarterly for the Division of Technical Information, USAEC). 97p.

Power reactor developments are reviewed. Abstracts are prepared for the eight sections. (N.W.R.)

For abstracts of individual sections see: 39394, 39442, 40028, 40489, 40490, 40817, 40912, and 40913.

40912 SHIPPINGPORT. Power Reactor Technol., 7: No. 2, 193-6(Spring 1964).

The operating experience of the Shippingport Pressurized Water Reactor is summarized. (N.W.R.)

40913 SEED AND BLANKET. Power Reactor Technol 7: No. 2, 197-200(Spring 1964).

The development and operation of Core 2 of the Shippingport Pressurized Water Reactor are reviewed. The fuel elements are of the plate type, composed of uranium dioxide–zirconium oxide wafers encased in Zircaloy-4 cladding. (N.W.R.)

40914 THE ÅGESTA NUCLEAR POWER STATION. A Staff Report by AB Atomenergi. B. McHugh, ed. Stockholm, AB Atomenergi, 1964.

A review is presented of the design, control and power instrumentation, siting and safety, waste handling and disposal, plant operation, and commissioning of the Ågesta Reactor. The Swedish reactor development program is also outlined. (T.F.H.)

40915 VODOPODGOTOVKA I VODNYI REZHIM ATOMNYKH ELEKTROSTANTSII. (Preparation of the Water Supply System and Water Circuit in Atomic Power Plants). A. A. Kot. Moscow, Atomizdat, 1964. 347p.

Physical and chemical properties of water used for reactor coolant are considered. Causes and methods for prevention of construction-material corrosion, scale formation, and impurity deposition in reactors, steam generators, and turbines are discussed. The book is written for personnel of nuclear power plants, engineers, technicians, and postgraduate students. (M.J.T.)

40916 EXPERIMENTAL GAS COOLED REACTOR (EGCR) CONTAINMENT SHELL LEAK RATE TEST. J. S. Busch and H. W. Hautala (Kaiser Engineers, Oakland, Calif.). 8p. (CONF-446-27)

From American Nuclear Society 10th Annual Meeting, Philadelphia, June 1964.

The measurement methods and data treatment techniques for determining the leakage rate of the EGCR containment vessel are reported. A typical determination yields a leakage rate of 0.053%/24 hr. (T.F.H.)

40917 EXPERIMENTAL GAS COOLED REACTOR CHARGE MACHINE. G. F. Gates and George Colville. 9p. (CONF-446-19)

From American Nuclear Society 10th Annual Meeting, Philadelphia, June 1964.

The EGCR charge machine is composed of: biological shielding; a pressure vessel located within this shielding; and internal operating mechanisms, which are used to service the reactor. The charge machine is positioned under the reactor vessel. The charge machine vessel nozzle is coupled to one of 16 reactor vessel nozzles, each of which serves 16 fuel channels. (T.F.H.)

40918 THE DEFINITION AND ACHIEVEMENT OF DEVELOPMENT TARGETS FOR THE CANADIAN POWER REACTOR PROGRAM. A. J. Mooradian (Atomic Energy of Canada Ltd., Chalk River, Ont.). Toronto, Canadian Nuclear Assn., 1964, Preprint 64-CNA-125, 21p. (CONF-539-17)

From Canadian Nuclear Association Conference on Canada's Role in a World of Expanding Nuclear Industry, Toronto, May 1964.

Possible methods are investigated for improving the economy of existing types of Canadian power reactors (e.g., by improvements in pressure tubes, fuel, instrumentation, or fuel development). Targets for the next series of Canadian power reactors are defined. (T.F.H.)

40919 ECONOMIC COMPARISON OF OYSTER CREEK, NINE MILE POINT, AND CANDU—TYPE STATIONS UNDER CANADIAN CONDITIONS. G. A. Pon (Atomic Energy of Canada Ltd., Chalk River, Ont.) and R. L. Beck. Toronto, Canadian Nuclear Assn., 1964. Preprint 64-CNA-107, 18p. (CONF-539-7)

From Canadian Nuclear Association Conference on Canada's Role in a World of Expanding Nuclear Industry, Toronto, May 1964.

The economics of Oyster Creek Power Reactor and Nine-Mile Point Power Reactor are modified for Canadian conditions, taking into account the station size, capital costs, fuelling costs, and operation and maintenance costs. The energy costs for these reactors are found to equal, or be slightly higher than, those for CANDU. (T.F.H.)

40920 THE PEACH BOTTOM ATOMIC POWER STATION SIMULATOR. R. H. Logue (Philadelphia Electric Co.), J. R. Ward, and H. A. Long. 18p. (CONF-629-1)

From 7th National Power Instrumentation Symposium, Denver, May 1964.

The training simulator installed as a permanent facility in the Peach Bottom Atomic Power Station is composed of a reactor operator's console, an instructor's console and oscillograph, a rod monitoring control board, a general purpose analog computer, and an auxiliary equipment cabinet. Three non-linear analog computer programs are used: the first describes the low-power range and includes only reactor kinetics and He flow mechanisms; the second is a model of neutron kinetics, reactor core heat transfer, He heat transport to the steam generators, heat transfer to the water and steam, and steam flow to the turbine; the third describes the buildup and decay of xenon poisoning. The simulator will be used to train new operators, maintain operator skills, and evaluate operating procedures and techniques. (A.G.W.)

40921 CONTROL CHARACTERISTICS OF AXIAL FLOW COMPRESSORS IN PARALLEL LOOP OPERATION FOR GAS-COOLED REACTORS. M. J. Kimbell and E. R. Gasser. 11p. (CONF-446-20)

From American Nuclear Society 10th Annual Meeting, Philadelphia, June 1964.

The EGCR has two coolant loops, each with a compressor and steam generator. The feedback control system used in EGCR, which tends to establish stable and synchronous operation of the two compressors, is described. (T.F.H.)

Production Reactors

40922 (HW-78897) FUEL CHARGING TESTS. Summary Report. W. M. Harty, S. M. Gill, and J. W. Riches (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Aug. 1, 1963. Contract [AT(45-1)-1350]. 15p.

Approximately 66 columns of N reactor fuel elements were charged using the N-reactor charging machine and employing fuel elements, equipment, and operating conditions closely simulating those to be used in reactor service. Charging with column forces slightly higher than those anticipated for initial charging of the reactor resulted in frequent incremental flattening of fuel element supports in a random manner and in unpredictable degree. The 2.9 inch to 2.7 inch taper in the front of the charging magazine, which is used to stop the travel of the charging piston, was identified as a source of support flattening. A degree of incompatibility between the fuel support shoes and the process tube leading to scratching was reaffirmed. There does not appear to be degradation of the shoe surfaces in the rest of the charging system that could be expected to significantly increase tube damage beyond the degree produced by the basic incompatibility. (auth)

40923 PLANS FOR DEVELOPING OF FAST BREEDERS. Asao Sugimoto. Nippon Genshiryoku Gakkaishi, 6: 356-8(June 1964). (In Japanese)

Recent world trends in fast breeder development are indicated, together with the associated problems. Japanese plans for fast breeder development are considered in view of these observations. (D.C.W.)

Propulsion and Space

Refer also to abstract 40736.

40924 (BAW-1187) N. S. SAVANNAH REACTIVITY MANUAL, FEBRUARY 1960. A. L. MacKinney and R. M. Ball (Babcock and Wilcox Co. Critical Experiment Lab., Lynchburg, Va.). Contract AT(11-1)-766. 23p.

A manual is presented for use as a reference during zero power and initial operation to convert neutron flux rate changes in the N. S. Savannah to the reactivity which induces the flux change. Curves of reactivity in cents versus reactor doubling time and curves converting reactor period and decades per minute to reactor doubling time are included. (J.R.D.)

40925 (GEMP-304) 630A MARITIME NUCLEAR STEAM GENERATOR PROGRESS REPORT NO. 10, JUNE 1–JULY 31, 1964. (General Electric Co. Advanced Technology Services, Cincinnati). Aug. 31, 1964. Contract AT(40-1)-2847. 81p.

The status of the 630A nuclear steam generator is presented. A feasibility and cost study was initiated to evaluate the effects of utilizing a propulsion turbine having 1050°F and 1500 psig for the throttle steam conditions. The associated performance gain would be about 1.9 points in total. Detailed specifications for the one-fourth scale flow test model for the primary coolant ducting were established. Alternate configuration studies using Zircaloy moderator tubes and helium as the primary coolant were initiated. Analyses of the moderator flow circuit indicate that acceptable pressure losses, velocities, and flow rates were attained. A study was made to determine insulation requirements for the unfueled region of the fuel element cartridge. The feasibility of using gusset plates instead of conical sections for support of the calandria tube sheets was established. A preliminary assembly procedure was established for the calandria vessel. Preliminary specifications were prepared for the reactor fuel design. Alternate designs for the fuel cartridge latch were studied. Nuclear analysis was completed on the end-of-life mockup and a report was issued. An investigation was made of the change in reactivity at the start of life as the fuel inventory is changed. Nuclear analysis is being performed for a core utilizing Zircaloy as the structure material. The critical experiment results (96 shim rod configuration with burnable poison over entire core length) are being analyzed by various techniques to determine the best method for correlation of reactivity and gross power distribution. Studies of alternate configurations of the bottom head for the shield plug are continuing. The pressure vessel configuration was revised to conform with the new and larger diameter reactor–shield-plug assembly. The radial shield thickness was revised and the dose rates were calculated on the core mid-plane. The earlier calculation of dose rates from fission products in the containment vessel was reviewed to establish the basis for the calculations and to determine whether or not the results are still applicable. Boiler flow stability analyses have indicated that no severe flow instability should occur between the parallel flow boiler tubes. Minor flow restrictions in the economizer section of the boiler will insure stability. The containment vessel leak rate design specification was changed. A preliminary list of containment vessel penetrations was prepared. Two-tube boiler control testing has continued using steam pressure to trim feedwater flow and steam temperature to trim airflow. Tests were started on new dynamic rod actuator shaft seals. Over 1240 hours of operation were accumulated on dynamic actuator No. 2. The laboratory test program for evaluation of 80Ni–20Cr as a 630A fuel material is continuing. A materials engineering study is in progress to determine the materials and processes for the 630A. Stress corrosion in the moderator loop and materials selection for major boiler components and the pressure vessel were studied. Computations were made to predict heating conditions within the fuel elements and moderator structure for the loss of air and moderator water coolant during core removal; extrapolations indicate that fuel melting would not occur until approximately 40 minutes after coolant loss, sufficient time for undertaking emergency measures. For a postulated fuel melting incident, calculations were made to estimate the equilibrium temperature of the shield diffuser and fuel plated out on the diffuser; results show several hours must elapse after the incident before the diffuser temperature becomes excessive. Layout drawings illustrating the present concept of the core removal fixtures was completed. The prototype test loop was revised to permit full-flow demineralization of the condensate. The critical experiment test operations continued and included measurements of heating rates, fast neutron dose rates, power distribution, and excess reactivity. (auth)

40926 (LAMS-3111) AUTOMATIC STARTUP FOR NUCLEAR REACTORS. G. L. Hohmann and B. G. Strait (Los Alamos Scientific Lab., N. Mex.). June 1964. Contract W-7405-eng-36. 41p.

An automatic startup technique for nuclear reactors was successfully tested and subsequently used on the Kiwi-B-4D-202 reactor in May 1964. The startup was achieved automatically by programming the control rods out rapidly to the approximate delayed-critical position and then continuing to move them slowly until the power reached a pre-

selected level. At this time the power control system was switched into operation. Thus, the reactor was automatically brought from a source power level (about $4 subcritical) through approximately 6 decades of power to a level slightly above the low end of the operating range of the logarithmic neutron detector used for full-power operation. At this power level the power control system was closed in a stable manner, and no significant heat-generation was present. Therefore, only one set of neutron detectors was required for reactor operation. The total startup time is adjustable from less than 30 seconds to several minutes. This automatic startup technique has been adopted for normal use in testing Rover reactors. (auth)

40927 (NAA-SR-6319) SNAP-2 POWER CONVERSION SYSTEM. MODEL 6 TWO-PHASE FLIGHT-PACKAGED SPEED CONTROL. Topical Report No. 27. W. E. Dauterman (Thompson Ramo Wooldridge Inc. TRW Electromechanical Div., Cleveland). Apr. 1964. For Atomics International, Div. of North American Aviation, Inc., Canoga Park, Calif. Contract [AT(11-1)-Gen-8], Subcontract N843FS-101221. 99p. (TRW-ER-5908)

The packaging effort to achieve the Model 6 flight speed control is summarized. This effort included the heat transfer analysis conducted prior to design of the Model 6 speed control, the first prototype flight package of the two-phase SNAP 2 control effort. Electrical and mechanical designs of the Model 6 speed control and fabrication procedures used during construction of the prototype unit are described. Results of temperature tests performed under atmospheric and vacuum conditions substantiated, from a thermal standpoint, the validity of the heat rejection analysis. Results of qualification-level shock and vibration tests proved the structural design to be adequate and showed there is no need for complete potting of the controller components. (auth)

40928 (NAA-SR-9252) MULTIPLE-UNIT SNAP-2 POWER SYSTEMS FOR MANNED APPLICATION. H. N. Rosenberg, ed. (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Jan. 28, 1964. Contract AT-11-1-GEN-8. 97p.

A study was made of the feasibility of utilizing multiple-unit SNAP 2 systems to provide power in the 10- to 40-kwe range for manned space stations. Principal areas of investigation were reliability, packaging, weight, and operational considerations. It is the conclusion of the study that man-rated multiple-unit systems are entirely feasible and within the state-of-the-art represented by the present SNAP 2 system. In addition, it is concluded that the increased reliability for partial power by use of redundant power conversion units makes this system very attractive. The multiple-unit SNAP 2 appears to be the most logical choice for early application of nuclear power to manned space stations. (auth)

40929 (NAA-SR-9801) SNAP MERCURY-RANKINE PROGRAM. MERCURY CONDENSING EXPERIMENTS. R. P. Forslund (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Aug. 1, 1964. Contract AT(11-1)-Gen-8. 89p.

An experimental study program of the various basic operating characteristics of mercury condensers for space applications is described. Included are techniques for predicting pressure drop in a variety of environments, condenser stability (both liquid leg stability and interface stability), the effects of noncondensibles, startup dynamics, and the differences between wetting and non-wetting condensing. Although the program is primarily based on obtaining accurate pressure-drop data in single horizontal tubes to simulate the zero-gravity of space operation, tilting and multitube capabilities are available. The greater emphasis of the discussion concerns existing models for predicting pressure drop. A description of the partially completed test facility is given along with the basic requirements of various pieces of equipment necessary to obtain accurate data. Tentative test plans are presented. (auth)

40930 (NAA-SR-Memo-9337) INTEGRATED THERMAL COMPATIBILITY TEST OF THE SNAP-10A/AGENA. H. Moore (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Dec. 18, 1963. Contract AT-11-1-GEN-8. 25p.

Under simulated operating conditions, utilizing the SNAP 10A-FSM-1 non-nuclear power unit and a calorimeter representing the Agena vehicle, rates of heat transmitted internally by radiation were measured. With the power unit at design thermal output, two operating conditions and three mean effective Agena temperatures were considered. Operation with startup temperature controller on resulted in maximum heat transfer rates; transfer rates at normal design point operation with controller off, following the end of active control, are also presented. All values include the effect of simulated solar heating of the NPU instrument compartment. (auth)

40931 (NAA-SR-Memo-9947) FLOWGO—COMPUTER CODE FOR REDUCTION OF DATA FROM VISUAL CORE MODEL TESTS. G. E. Dufoe (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). May 12, 1964. Contract AT-11-1-GEN-8. 44p.

A computer program, FLOWGO, was written to expedite the reduction of photographic test data obtained from the Vanguard Film Analyzer used with the visual core model. Both axial and radial flow distributions are determined from the results of the code. Plots of axial flow distribution for each coolant channel are obtained by use of AICRT 4. The effects of orificing and cross-flow are shown by analysis of the radial and the axial flow distributions, respectively. The report was prepared for the interim SNAP 10A/2 design. (auth)

40932 (NP-14234) SNAP-8 PROGRAM STATUS REVIEW MEETING AT VON KARMAN CENTER, JULY 22, 1964. (Aerojet-General Corp., Azusa, Calif.). 176p.

A survey of testing programs for components of SNAP-8 is given; results verified and tests to be initiated are included. Rotating machinery components tested include the turbine alternator assembly, NaK pump-motor assemblies, mercury pump-motor assembly, lubricant-coolant pump-motor assembly, and bearings. Seal-to-space interdiffusion was simulated. The Rated Power Loop no. 2 was used to evaluate the hot-mercury-vapor turbine and heat exchanger performances. The materials development program features liquid metal corrosion loop designs and uses. The boiler tubes of the Power Conversion System were tested under superheat, pressure, and mercury inventory variations, and the condenser temperature profiles were studied. Voltage regulators and speed controls for the turbine alternator system were developed, and radiations effects on isulation materials, resistors, capacitors, rectifiers, silicon diodes, and electrical subsystems were analyzed. The performance of the SNAP-8 power conversion system (boiler, condenser, Hg-PMA, and Hg flow control) was evaluated. Condenser control was analyzed. Prototypes and reference design for SNAP-8 evaluations are described. (R.E.U.)

40933 (TID-21054) REPORT ON N. S. SAVANNAH. D. B. Hall (Advisory Committee on Reactor Safeguards, AEC). Nov. 13, 1963. 2p.

The proposed dockside operation of the N. S. Savannah at 30 Mw(t) was analyzed by the Reactor Safeguards Committee, and positive recommendations were made. (R.E.U.)

40934 AEC REPORT ON SYSTEMS FOR NUCLEAR AUXILIARY POWER (SNAP). Isotopes Radiation Technol., 1: No. 4, 325-9(Summer 1964).

The official philosophy and scope of the AEC's future program in the SNAP program is outlined, through evaluation of the SNAP program. (N.W.R.)

40935 SNAP ISOTOPE PROGRAM. Isotopes Radiation Technol., 1: No. 4, 329-38(Summer 1964).

The justification of radioisotopic-fueled SNAP, as contrasted with alternative sources of power, is evaluated. The radioisotopic-fueled systems are superior in satisfying some or most of the following criteria: maximum reliability; minimum system cost; minimum space, weight, and payload interface requirements; maximum useful life and radiation resistance; maximum structural integrity; compatibility with environment; and maximum safety and minimum radiation hazard. Radioisotope availability and cost are analyzed. The requirements and potential applications for radioisotopic-fueled SNAP are summarized. (N.W.R.)

40936 DESIGN AND PROPERTIES OF THE ADVANCED PRESSURIZED-WATER REACTOR (FDR) FOR THE GERMAN NUCLEAR RESEARCH SHIP. W. Jahns (Babcock & Wilcox-Dampfkessel-Werke AG, Oberhausen, Ger.). Kerntechnik, 6: 324-32(July-Aug. 1964). (In German)

The entire primary circuit of the FDR reactor, including the steam generator, is contained in one pressure vessel. The reactor is described, and its characteristics are given. (D.C.W.)

40937 PROGRAM FOR DEVELOPING MARINE REACTORS. Keijiro Inoue. Nippon Genshiryoku Gakkaishi, 6: 361-3(June 1964). (In Japanese)

Marine reactor development is reviewed from the technical point of view, and the main features of recently developed marine reactors are outlined. The program for developing the first nuclear ship in Japan is described, and the specifications of the indirect-cycle, light-water reactor are given. (auth)

40938 NUCLEAR GAS ENGINE (Engineering Materials). (Oak Ridge National Lab., Tenn.). (CAPE-1101).

Preliminary study drawings (8) are available for a nuclear gas engine, a new type of prime mover especially suited for marine propulsion. It consists of a reciprocating engine coupled to a gas-cooled reactor. This system employs a single fluid circuit without high temperature heat exchangers. The system is insensitive to small leaks. The neutron economy is good, and fuel costs are low. For a listing of individual titles, see the Engineering Materials List (TID-4100). (C.E.S.)

40939 REACTOR PHYSICS OF NUCLEAR ROCKET REACTORS. R. K. Plebuch and K. F. Hansen (Massachusetts Inst. of Tech., Cambridge). 6p. (CONF-446-33)

From American Nuclear Society 10th Annual Meeting, Philadelphia, June 1964.

The effects of various core, reflector, and coolant variables upon the criticality and power distribution in nuclear rocket reactors are studied. The principal system studied is a fully enriched, graphite-moderated, nonsymmetrically reflected, hydrogen-cooled reactor having uniform and nonuniform fuel distributions. Consideration is also given to bare, homogeneous, spherical systems. The goal of the study is the maximization of the specific power of the rocket reactor. (T.F.H.)

Research and Test Reactors

40940 (AEET/ROD/8) APSARA REACTOR OPERATING EXPERIENCE REACTOR PHYSICS. N. Veeraraghavan, D. B. Upendra, and R. Narain (India. Atomic Energy Establishment, Trombay). 1963. 17p. (CONF-243-59)

From American Nuclear Society Conference on Problems of Operating Research and Power Reactors, Ottawa, Oct. 1963.

Reactor physics operating data collected for different loading configurations at intermediate burnup are reported for APSARA, a 1-Mw pool type research reactor. The data include reactivity measurements, xenon poisoning, burnout rate, heat losses from pool water, and temperature and void coefficients of reactivity. (D.L.C.)

40941 (BAW-208) BABCOCK AND WILCOX TEST REACTOR. Hazards Summary Report, July 1963. (Babcock and Wilcox Co. Atomic Energy Div., Lynchburg, Va.). 119p.

The Babcock & Wilcox Company has constructed and proposes to operate a nuclear reactor, the Babcock & Wilcox Test Reactor. The major topics discussed in the hazards report are: characteristics of the nuclear facilities site; design and operation of the reactor; organization and procedures necessary to operate the reactor safely; and accident analysis of the reactor. (auth)

40942 (EUR-1643.e(p.51-86)) THE SORA REACTOR. V. Raievski (European Atomic Energy Community. Joint Nuclear Research Center, Ispra, Italy).

A description is given of the fast pulsed reactor program, which for the last two years has been under study by Euratom in cooperation with the firms of Belgonucléaire and Siemens-Schuckertwerke. The reactor will serve as a repetitively pulsed source for neutron physics experiments over a wide energy range. The main pulse characteristics are: repetition rate, 100 cps; pulse half-width, 50μsec; and ratio of maximum pulse power to mean power, 130. At its design power of several hundred kilowatts, the reactor will be competitive with other modern high-intensity neutron sources, particularly for beam experiments with slow neutrons of up to a few electron volts. The reactor core consists of enriched uranium alloy fuel elements cooled by NaK. Periodic super prompt-critical reactivity pulses are produced by a reflecting sample mounted on a wheel rotating at high speed next to one face of the core. A conceptual design of the reactor is presented, which satisfies the requirements of the experimental users while assuring safe and stable reactor operation. Special methods that were developed for reactor physics design, neutron kinetics, and reactor dynamics are described. (auth)

40943 (HW-81423) CHEMICAL DECONTAMINATION OF THE PLUTONIUM RECYCLE TEST REACTOR—OPERATIONAL ASPECTS. J. E. Hard (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Mar. 20, 1964. Contract AT(45-1)-1350. 20p.

The Plutonium Recycle Test Reactor operation was interrupted in 1962 owing to a failed PuO_2–MgO fuel element with a cladding split. The incident resulted in gross plutonium and fission product contamination of the primary coolant system. Oxalic acid-hydrogen peroxide

solutions for particulate dissolution and alkaline permanganate-oxalic acid solutions for film removal were used and found to give satisfactory decontamination factors. Recommendations are given for precautionary operations and for the design of reactors for simplified decontamination operations. (D.L.C.)

40944 (IDO-16977) MATERIALS TESTING REACTOR-ENGINEERING TEST REACTOR TECHNICAL BRANCHES. Quarterly Report, October 1–December 31, 1963. (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). May 1964. Contract AT(10-1)-205. 82p.

Four chapters are included; separate abstracts have been prepared for each. (T.F.H.)

For abstracts of individual chapters see: 39567, 39793, 40474, and 40753.

40945 (IDO-16997) HEAVY WATER HANDLING EXPERIENCE IN THE SPERT II REACTOR FACILITY. C. R. Montgomery (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). July 1964. Contract AT(10-1)-205. 32p.

The Spert II reactor is a pressurized-water research reactor constructed to provide a facility for conducting reactor kinetic behavior and safety studies. The facility provides for the alternate use of both light water and heavy water as coolant-moderators, and also can accommodate frequent changes in core types and configurations. The report describes the particular design features of the facility that provide for the conservation of heavy water and the handling techniques developed in order to minimize losses and maintain isotopic purity of the heavy water inventory. (auth)

40946 (IDO-17010) SPERT PROJECT QUARTERLY TECHNICAL REPORT, JANUARY–MARCH 1964. A. H. Spano, ed. (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). July 1964. Contract AT(10-1)-205. 73p.

An analysis of the transient data from the 2.2-msec-period test of the Spert I oxide core conducted in the preceding quarter was made to determine the reactivity feedback contributions provided by Doppler and non-Doppler mechanisms. The results of this analysis show that a large non-Doppler reactivity compensation effect (associated with the steam and moderator heating effects developed as a consequence of fuel pin rupture) was rapidly generated at the rate of about 500 $/sec, reaching its approximate maximum value of 3.6$ about 7 msec after its initiation at about the time of peak power. A metallurgical examination of the cladding in the two ruptured fuel pins revealed the rupture to be transgranular in nature, supporting the hypothesis of a rapid cladding break caused by a steam explosion in waterlogged fuel. In preparation for an additional, shorter period test of the Spert I core, calculations were made to determine the maximum reactivity insertion that can be made available in Spert I in order to obtain the maximum burst energy release. The results indicate that the combination of a particular control rod ramp insertion and a transient rod step insertion can provide a maximum insertion of as much as 3.2$, equivalent to a minimum asymptotic reactor period of about 1.6 msec. An initial series of transient tests on the Spert II close-packed, D_2O-moderated core was carried out under no-flow, ambient-temperature conditions, with the system pressure at atmospheric and at 360 psig. The tests were initiated by step insertions of reactivity in the range from about 0.5 to 1.8$, resulting in asymptotic periods in the range from 5 sec to 74 msec. The transient power and fuel plate surface temperature data indicate that for the atmospheric-pressure tests reactor shutdown by steam formation is precluded in tests with periods longer than about 0.7 sec, whereas for the 360-psig tests, boiling shutdown is precluded for periods longer than about 0.2 sec. From an analysis of the transient data, the value for the reduced prompt neutron lifetime for the close-packed core is determined to be 64 ± 2 msec. Transient testing of the Spert III plate-type core was resumed with a series of 29 self-limiting transients conducted at system temperatures of ambient, 240, and 360°F and at various system pressures and flow rates. These tests permitted a check of the reproducibility of the transient test results obtained previously, and provided additional data on the effect of system temperature on the dynamic behavior of the reactor, which are required prior to performing transient tests at system temperatures above 400°F. An analysis of the recent transient test data has yielded the value of 2.9 ± 0.4 msec for the reduced prompt neutron lifetime of the Spert III core, a value somewhat more precise than that deduced from the earlier data. Calculations of the steady-state power levels required to obtain departure-from-nucleate-boiling conditions in the Spert III core for various system conditions were also completed during the quarter. Several instability-threshold and reactor-ringing tests were performed in Spert IV during the quarter. Analyses of the reactor noise data and of the peak power data obtained from the ringing tests indicate that the threshold for diverging instability in Spert IV is obtained in the case of an 18-ft-hydrostatic head, natural-circulation condition when the total reactivity insertion is equal to about 4.5$. Calculations have been made to determine the thermal properties of the two-phase distribution of the moderator in the average standard-width and narrow-width channels of the Spert IV core under no-flow conditions. The results were used to determine the reactivity feedback distribution in the nonboiling and bulk-boiling zones of the two types of coolant channels. The analysis indicates the onset of bulk boiling in the narrow channel to occur at an equilibrium mean power level between 6 and 7 Mw, and in the standard channel at a power level of about 11 Mw. The initial diffusion-testing phase of the PBF fuel testing program was completed. The results of tests conducted in a He atmosphere for eight hours at temperatures as high as 2450°C indicate negligible diffusion of the UO_2 from the fuel pellet to the surrounding zirconia annular region in the PBF fuel rod. Preparations are underway for initiating the remaining phases of the fuel testing program, and for conducting a series of clean-core critical experiments, in which simulated PBF fuel rods in highly-packed configurations will be utilized to obtain experimental data for checking the calculational methods employed in the final design of the PBF. A frequency response analysis of the nonboiling reactivity feedback in Spert III was performed as an additional approach to the problem of computing this feedback effect. The results obtained by this method are found to be consistent with the results obtained on the basis of the physical model. An analysis of the contribution of delayed neutrons to the total energy release obtained in a super-prompt-critical power excursion was made for the case where the reactivity compensation is proportional to the n^{th} power of the time-varying energy release. (auth)

40947 (IDO-24455) ADVANCED TEST REACTOR TEMPERATURE AND VOID COEFFICIENTS OF REACTIVITY. F. M. Alcorn, R. A. Mickle, and C. B. Woodhall (Babcock and Wilcox Co. Atomic Energy Div., Lynchburg, Va.). Mar. 1964. For Ebasco Services, Inc., New York. Contract AT(10-1)-1075. 28p. (S-R-135)

Spatially dependent temperature and void coefficients of

reactivity were calculated for the reference core of the Advanced Test Reactor. Coefficients have been determined for cold and hot-operating reactor conditions at both the beginning- and end-of-life. The fuel temperature coefficient is negative (-1.37×10^{-4} $\Delta\rho_T$/°F) for the beginning-of-life, hot-operating condition; all other regions have positive temperature coefficients, the largest being $+0.38 \times 10^{-4}$ $\Delta\rho_T$/°F for all nine traps. The cold to hot-operating temperature deficit of reactivity is +0.0060. The beginning-of-life, hot-operating, fuel void coefficient is -0.209 $\Delta\rho/\Delta V/V$ while all other regions are positive; the largest positive void coefficient is +0.0149 $\Delta\rho/\Delta V/V$ for an all water A-1 trap. End-of-life coefficients are similar to beginning-of-life coefficients; fuel coefficients are negative while all other regions have positive coefficients. The fuel temperature coefficient has become less negative; its value is -0.97×10^{-4} $\Delta\rho_T$/°F at the end-of-life. The temperature coefficients for other regions remain the same with time. End-of-life void reactivity additions have all increased over beginning-of-life values. Seventy per cent void in an all water A-1 trap causes a +0.0092 $\Delta\rho$ addition to the system reactivity at end-of-life conditions whereas the same perturbation at beginning-of-life conditions will add only +0.0085 $\Delta\rho$ to the system reactivity. (auth)

40948 (IDO-24458) NUCLEAR ANALYSIS OF THE ADVANCED TEST REACTOR CRITICAL EXPERIMENTS. H. M. Jones, R. J. Neuhold, and R. A. Turner (Babcock and Wilcox Co. Atomic Energy Div., Lynchburg, Va.). Dec. 1963. For Ebasco Services, Inc., New York). Contract AT(10-1)-1075. 133p. (S-R-132)

The Advanced Test Reactor Critical Experiment (ATRCE) was built at the Critical Experiment Laboratory of the Babcock and Wilcox Company in Lynchburg, Virginia. A comprehensive experimental program was carried out to provide the experimental data necessary for the development and evaluation of the theoretical model used in the physics design of the ATR. The theoretical model was evolved in the course of the design of the ATR. The model is a 40-group spectral code used in conjunction with a PDQ 4-group 2-dimension code. The basic validity of the model is demonstrated in the nuclear analysis performed to reproduce the ATRCE experimental data. Minor changes that have been made to the model principally involve changes to the 2-dimensional grid geometric representation. The major areas of investigation are: the gross and fine structure power distribution in the fuel and test regions; the determination of criticality for varied reactor conditions; region temperature and void coefficients of reactivity; and neutron flux spectrum in the epithermal and thermal energy ranges. In establishing the validity of the theoretical model, emphasis was placed on the calculation of the gross and fine structure power distribution in the core, and secondly on predictions of core reactivity effects. (auth)

40949 (NP-14285) ANNUAL REPORT OF OPERATIONS, JULY 1960–JUNE 1961. (Westinghouse Electric Corp. Testing Reactor, Waltz Mills, Penna.). July 19, 1961. 6p. (DOCKET-50-22)

The operating experience at the test reactor is reported along with significant plant changes, reactor utilization, and operating procedures. (J.R.D.)

40950 (NP-14288) HAZARDS SUMMARY FOR THE L-77 LABORATORY REACTOR FOR THE UNIVERSITY OF NEVADA, RENO. (Nevada. Univ., Reno). [1962]. 59p. (DOCKET-50-202)

The L-77 Laboratory Reactor is to be installed in the Nuclear Engineering Building on the Reno campus of the University of Nevada. The Hazards Summary Report consists of two parts: Part I presents site data, including information of area geography, geology, seismology, climatology, and hydrology, and administrative aspects of the facility; Part II describes the reactor, its uses, and its performance characteristics, and presents analyses of the nuclear, radiation, and operational hazards. (auth)

40951 (NP-14289) SAFETY ANALYSIS REPORT. REVISION II. (Western New York Nuclear Research Center, Inc., Buffalo). Sept. 23, 1963. 158p. (DOCKET-50-57)

The design, location, operation, and hazards analysis of the research reactor located at the Western New York Nuclear Research Center are discussed. The report supersedes the Hazards Summary Report dated March 3, 1958, the amendments thereto, and Hazards Summary Report, Revision I, dated January 21, 1963. (auth)

40952 (ORNL-TM-918) OAK RIDGE RESEARCH REACTOR QUARTERLY REPORT, APRIL–JUNE 1964. W. R. Casto and W. H. Tabor (Oak Ridge National Lab., Tenn.). July 31, 1964. Contract W-7405-eng-26. 33p.

Operation time was considerably lower (77.7%) because a lengthy shutdown was required for installation of the improved shim-rod drives. A multisection, dual-purpose chamber was installed for testing. Mission-type check valves were installed on primary pumps. An experiment vibrating in the core caused reactivity changes that looked very much like boiling. The caustic scrubber that was in the building emergency ventilation system was replaced with filter-charcoal units which were tested with elemental iodine tagged with iodine-131. Results showed the units to be 99.8% efficient. (auth)

40953 CONSTRUCTION OF THE PÉGASE REACTOR. Paul Faurot (Commissariat à l'Énergie Atomique, Paris). Energie Nucl., 6: 197-205(June 1964). (In French)

A general description of the design and construction of Pégase is reviewed, a pile which will be used to test materials under radiation, and which is now in operation. The originality of this research tool lies in the fact that the experiments are carried out outside of the core, as well as the scope and number of these experiments and the use of moving loops. Some particular technical difficulties and the solutions that were adopted to cope with them are presented. (auth)

40954 FUEL ELEMENTS FOR RESEARCH REACTORS IN THE FEDERAL REPUBLIC OF GERMANY. H. Eschnauer (Nuklear-Chemie und -Metallurgie GmbH, Wolfgang, Ger.). Kerntechnik, 6: 347-9(July-Aug. 1964). (In German)

The three different types of fuel elements used in German research reactors are described, together with their fabrication. (D.C.W.)

WASTE DISPOSAL AND PROCESSING

40955 (AEET/HP/RWD/3) DISPOSAL OF WASTE IN COASTAL WATERS. Working Party No. 4. P. R. Kamath and A. K. Ganguly (India. Atomic Energy Establishment, Trombay). Jan. 27, 1959. 40p.

A treatment is presented of the various factors to be considered for the ultimate disposal of radioactive wastes in sea water. The chemistry (constituents and radioactivity) and physics (circulation, sedimentation, etc.) of sea water are described. Chemical and biological interactions of radioactive wastes are considered. (D.L.C.)

40956 (HW-77380) CHEMICAL AND RADIOCHEMICAL ANALYSES OF TK-241-A-103 SLUDGE. Final Report. T. R. McKenzie (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Apr. 10, 1963. Contract AT(45-1)-1350. 8p.

Core samples from top, center, and bottom sections of the Tk-241-A-103 sludge were analyzed. The constituents which were determined included Pu, Np, U, common anions and cations, and various fission products, including five Sr isotopes. (D.L.C.)

40957 (NP-8519) EUROCHEMIC WASTE TREATMENT PROPOSAL. M. Lung, F. Marcus, H. H. Ph. Moeken, and A. Redon (European Company for the Chemical Processing of Irradiated Fuels, Mol, Belgium). Sept. 21, 1959. 10p. (ETR-69)

Flowsheets are presented for the disposal of sanitary, cold, warm, and hot waste. Methods of final disposal of hot waste are discussed. (J.R.D.)

40958 (ORNL-TM-882) FORMATION OF LOW LEACHABLE GLASSES FROM RADIOACTIVE WASTES USING THE RISING LEVEL TECHNIQUE IN STANDARD POT CALCINATION EQUIPMENT. C. W. Hancher and J. C. Suddath (Oak Ridge National Lab., Tenn.). Sept. 1964. Contract W-7405-eng-26. 39p.

There is a safety advantage in handling radioactive waste as a massive glass-like solid of low leachability rather than a calcined solid which tends to crumble easily and has a higher solubility in ground water. Tests were made to see if a glass-like product could be made in standard pot calcination equipment. These tests were successful. Using the rising level technique, the feed rate to the calciner vessel is controlled so that only 1 ft of aqueous liquid is held up at any one time. The liquid holdup is limited because of the layered nature of the system. If the calcined solid which acts as a separation barrier between the molten glass on the bottom and the aqueous liquid should fracture allowing the aqueous liquid and melt to contact each other, there would be a vigorous steam reaction which could cause an instantaneous high pressure surge. Three tests using this rising level technique were completed. Two tests were made using TBP-25 waste to which monosodium phosphate and lead nitrate were added to form a glass. One test was made using FTW-65 X 3 Purex waste to which lithium hydroxide and aluminum nitrate were added to form a meltable mixture and calcium nitrate was added to reduce sulfate volatility. In an 8 in. dia × 80 in. long calciner pot the average feed rates were 5 to 8 liter/hr for the two types of waste fed. There was some difficulty with solids collecting in the off-gas lines. The solids were easily removed by frequent flushing of the off-gas line with dilute nitric acid or water. The rising level technique in standard pot calcination equipment is a feasible procedure for solidification of radioactive wastes into low leachable glass-like product. (auth)

40959 (RFP-396) RECOVERY OF PLUTONIUM FROM INCINERATOR ASH. F. E. Butler, J. D. Moseley, and G. F. Molen (Dow Chemical Co. Rocky Flats Div., Golden, Colo.). July 31, 1964. Contract AT(29-1)-1106. 22p.

A method for the recovery by dissolution of Pu from ash produced by combustion of Pu-contaminated burnables is described. The ash should be finely ground and completely oxidized prior to dissolution. Nitric acid and fluoride ion are the dissolution agents. The dissolution rate, which is directly proportional to the fluoride ion concentration, increases rapidly with temperature. (auth)

40960 (UJV-1103/64) FILTRATSIYA AEROZOLEI V PARE PRI POMOSHCHI VOLOKNISTYKH FIL'TROV. (Filtration of Aerosols in a Vapor by Means of Fibrous Filters). F. Kepak (Československá Akademie Věd. Ústav Jaderného Výzkumu, Řež). [1960?]. 11p.

Tests were made of the filtration efficiency of fibrous filters for aerosols during decontamination of radioactive liquid waste by evaporation. The filtration efficiency was determined for 20-, 15-, 6-, and 3-μ silicon fibers and 3-μ basalt fibers. (R.V.J.)

40961 (UJV-1104/64) PRAKTICHESKIE PROBLEMY PO DOZIMETRII RADIOAKTIVNYKH OTKHODOV. (Practical Problems in Dosimetry of Radioactive Wastes). Ya. Ralkova (Ceskoslovenska Akademie Ved. Ustav Jaderneho Vyzkumu, Rez). [1964]. 6p.

Four basic methods of waste concentration; coagulation and coprecipitation, evaporation, ion exchange, and radiochemical separation; are discussed, and their efficiencies and shortcomings are analyzed. Devices for measuring α, β, and γ emission from waste are described, and difficulties in treating the data are discussed. (R.V.J.)

40962 (UJV-1105/64) VVEDENIE RADIOIZOTOPOV V RASPLAVLENYE PORODY. (Radioisotope Incorporation into Molten Rocks). J[aroslav] Saidl (Československá Akademie Věd. Ústav Jaderného Výzkumu, Řež). [1963]. 9p.

Small diffusion coefficients secure safe incorporation of highly radioactive wastes in molten basalt when the casting is buried in underground compartments. The evolution stages prevent the diffusion of moisture and exclude elution of radioactive material. Measurement shows that Cs and Sr diffuse in crystalline basalt at 10^{-17} to 10^{-15} cm/sec^{-1} at normal temperature, guaranteeing safe fixation of even the longer-life radioactive wastes. (R.V.J.)

40963 POT CALCINATION OF SIMULATED RADIOACTIVE WASTE WITH CONTINUOUS EVAPORATION. C. W. Hancher and J. C. Suddath (Oak Ridge National Lab., Tenn.). Chem. Eng. Progr., Symp. Ser., 60: 105-10(1964).

Process equipment and a control system were developed for an evaporation-calciner process for reduction of radioactive waste solutions to solids. A 25-liter evaporator close-coupled to an 8-in. dia by 90-in.-long calciner was operated and controlled successfully. The liquid filling rates for Purex waste and TBP-25 wastes were 20 to 30 liters/hr. The evaporator overhead decontamination factor was about 10^3. (auth)

40964 RESEARCH ON PRODUCTION AND EXCHANGEABILITY OF LIGNIN SULFONIC ACID CONDENSATION PRODUCTS FOR PURIFICATION OF RADIOACTIVELY CONTAMINATED WASTES. S. Riedel (Zentralinstitut für Kernphysik, Rossendorf, Ger.). Symp. Tech. Zagadnien Ochrony Promieniowaniem, Warsaw, 500-16(1962). (In German)

Condensation products of lignin sulfonic acids can be refined from the sulfite waste liquor of the cellulose industry by heating under pressure. These lignin sulfonic acid condensation products can be used as economic cation exchangers in the purification of radioactive wastes because of their content of groups with ion exchanger properties. The dependence of the exchange properties on the type of waste liquor and the preparation conditions are described. The uptake of individual fission products from wastes and laboratory investigations on the decontamination of reactor wastes are briefly considered. (tr-auth)

40965 SORBENT SCRAP MATERIALS FOR PURIFICATION OF ACTIVE WASTE. Z. Smal (Inst. of Nuclear Research, Warsaw). Symp. Tech. Zagadnien Ochrony Promieniowaniem, Warsaw, 517-41(1962). (In Polish)

The use of scrap materials in the form of blast-furnace slag for the purification of radioactive wastes is described. The results obtained on the absorption of ^{90}Sr, ^{137}Cs, ^{95}Zr, ^{144}Ce, and ^{106}Ru from waste solutions were analyzed. The effects of parameters such as temperature and flow velocity were taken into consideration. The possibility of the appearance of capillary-active materials in the wastes purified by this method was considered. (tr-auth)

40966 DECONTAMINATION OF RADIOACTIVE WASTES WITH A TRANSPORTABLE ION EXCHANGE INSTALLATION. A. Dagen. Symp. Tech. Zagadnien Ochrony Promieniowaniem, Warsaw, 542-5(1962). (In German)

In work with radioisotopes, radioactive contaminated wastes occur which are collected in storage vats at the institutions. If the maximum permissible concentration is exceeded for surface waters, these must not be released into the drainage system, but must be processed. The operation of a portable ion exchange installation, which is installed at the individual institutions according to need, is described. (tr-auth)

40967 PURIFICATION OF RADIOACTIVE WASTES WITH NATURAL ORGANIC ION EXCHANGERS. R. Winkler (Zentralinstitut für Kernphysik, Rossendorf, Ger.). Symp. Tech. Zagadnien Ochrony Promieniowaniem, Warsaw, 546-59(1962). (In German)

Natural ion exchangers are often used for the decontamination of radioactive wastes as they can be discarded after one use because of their low cost. The organic materials of this group, such as lignite, peat, and wood, can also be burned so that the adsorbed radioactive impurities can be concentrated in the relatively small ash volume. The use of natural organic ion exchangers is made difficult by the relatively low alkali resistance and by the weakly acid character of the exchange-active groups. Problems are discussed on the basis of some studies on humic acid and peats. It was proved that natural organic exchangers can be used when the water to be treated has no extreme pH value, contains low levels of inactive salts, and contains the impurities to be removed in cationic and colloidal form. (tr-auth)

40968 PROBLEMS IN USE OF AN ION EXCHANGER MADE FROM PEAT AND BENTONITE CLAY. G. Sachse and R. Winkler (Zentralinstitut für Kernphysik, Rossendorf, Ger.). Symp. Tech. Zagadnien Ochrony Promieniowaniem, Warsaw, 560-79(1962). (In German)

Natural ion exchangers have great possibilities for the purification of radioactive waste solutions. Organic exchangers such as peat, lignite, or other humus-containing substances, and inorganic exchangers, such as silicate clays, are suitable. In the use of exchangers containing humic acid, the most essential disadvantage is the solubility of the alkali humates arising in the exchange process. Clay exchangers, which are partly cesium selective, produce great difficulties because of their high swelling properties. A combination of peat and bentonite clay eliminates these disadvantages to a great extent. The combined exchanger has available sufficiently stable grain structure and reduces the formation of Cs humate when Cs-selective clays are used. The simple preparation of the exchangers and their properties are described. The stability, swelling behavior, and capacity with various clay components are shown. The exchange properties are characterized by examples of ^{137}Cs, ^{90}Sr (or ^{89}Sr), ^{144}Ce, and fission product mixtures. (tr-auth)

40969 POSSIBILITIES FOR IMPROVEMENT OF WATER-FREE PRECIPITATES IN PURIFICATION OF RADIOACTIVE WASTES BY THE WIRBOS PROCESS. G. Sachse (Zentralinstitut für Kernphysik, Rossendorf, Ger.). Symp. Tech. Zagadnien Ochrony Promieniowaniem, Warsaw, 609-23(1962). (In German)

In the purification of radioactive wastes by precipitation methods, great difficulties arise in the separation and further processing of radioactive precipitates containing large concentrations of water. In the Central Institute for Nuclear Physics at Rossendorf, the Wirbos method was investigated and further developed to make possible the precipitation of the hardening components of water as solid, water-free precipitates. In this method the bicarbonate hardening components of water were precipitated with $Ca(OH)_2$ as lime water. The precipitates were then separated on contact grains and held in the material by the flow-through water in the conical vessel in which the reaction was carried out. The contact mass adhered to contact spheres with a diameter of 5 to 7 mm and could easily be separated by draining of the liquid phase from the reaction vessel. On the basis of the investigations, it could be shown that not only the bicarbonate hardeners were removed, but it was possible to remove part of the permanent water hardeners. Preliminary results obtained with a pilot-plant installation working on the Wirbos principle are reported. (tr-auth)

GENERAL AND MISCELLANEOUS

40970 (BMI-1674(Del.)) PROGRESS RELATING TO CIVILIAN APPLICATIONS DURING JUNE 1964. Russell W. Dayton and Ronald F. Dickerson (Battelle Memorial Inst., Columbus, Ohio). July 1, 1964. Contract W-7405-eng-92. 46p.

Research and development progress on reactor materials and components, fuels, fuel elements, radioisotope and radiation applications, coated-particle fuel materials, materials development program, fuel irradiation, corrosion studies of the fluoride volatility process, creep-rupture of SAP alloys, mechanical properties of zirconium alloys, fission-product deposition, gas-cooled reactors, and small radioisotope power sources is reported. (M.C.G.)

40971 (BNL-7683) THERMAL DECOMPOSITION AT DEFECTS. J. Jach (New York. State Univ., Stony Brook). [1963]. Contract AT-30-2-GEN-16. 18p. (CONF-489-3)

From 5th International Symposium on the Reactivity of Solids, Munich, Aug. 1964.

A decomposing solid classically involves the two processes nucleation and growth. In view of the three dimensionality of the reaction, the combination of these two processes leads in general to a kinetic scheme which involves some form of acceleratory and decelerator region. Thus a plot of percentage of total reaction vs. time yields a curve of sigmoidal character. Depending on the system and temperature, various portions of this curve may predominate at the expense of others. Since the system is three dimensional, linear kinetics are observed only under extremely abnormal circumstances such as preferential reaction along certain single directions. During the course of some recent solid state decomposition studies of reactions of the type Solid A → Solid B + gas it was observed that at very low relative temperatures, where reactions may occur at a rate of the order of 10% per week, the kinetics became linear in three chemically distinct systems. These three systems displayed different thermal decomposition kinetic schemes at high temperatures but as the temperature was lowered the kinetics became linear, i.e., pressure was proportional to the time. The three systems are α-lead azide, nickel oxalate and sodium bromate. The linear kinetics were interpreted in terms of preferential decomposition along dislocation lines. It is postulated that such a mode of decomposition is energetically more favorable at regular reactant-product interfaces and, therefore, proceeds with a somewhat lower activation energy than the normal reaction and will thus be noticed only at relatively lower temperatures. The progress of the reaction along dislocation lines is linked to a reverse of the Frank mechanism for crystal growth from slightly supersaturated solutions. (auth)

40972 (CALT-221-3) KINETICS OF TRANSFORMATION OF METASTABLE SILVER–COPPER SOLID SOLUTIONS. Technical Report No. 28. Ronald K. Linde (California Inst. of Tech., Pasadena. W. M. Keck Lab. of Engineering Materials). July 1964. Contract AT(04-3)-221. 117p.

Metastable solid solutions were obtained at compositions across the entire range from 0 at. % Ag; Cu to 100 at. % Ag; Cu by rapid quenching from the liquid state. Lattice parameters were measured by x-ray diffraction in Debye-Scherrer powder cameras. The enthalpy of solid solution of the 75.0 at. % Ag; Cu composition was determined calorimetrically and is discussed in relation to the predictions of existing theories. The process of transformation of the metastable solid solutions into the equilibrium phases was studied by means of x-ray diffraction intensity measurements, electrical resistance measurements, and optical microscopy. Results are compared with those for an alloy quenched from the solid state at a composition which exists as a solid solution at elevated temperatures. Activation energies were computed and are shown to be compatible with a diffusion controlled growth process in which most of the nuclei are present very early in the process. (auth)

40973 (EUR-1643.e) EURATOM'S SCIENTIFIC ACTIVITIES. JOINT NUCLEAR RESEARCH CENTER ISPRA ESTABLISHMENT. (European Atomic Energy Community. Joint Nuclear Research Center, Ispra, Italy). 1964. 364p.

Separate abstracts were prepared for 22 of the 26 papers included; 4 were previously abstracted for NSA (17: 8003; 18: 11141, 24605, and 37796). Subjects are varied and range from chemistry to reactor physics. (R.E.U.)

For abstracts of individual papers see: 39058, 39154, 39155, 39156, 39278, 39279, 39790, 39791, 39992, 39993, 40117, 40468, 40469, 40470, 40471, 40472, 40473, 40504, 40735, 40780, 40806, and 40942.

40974 (HW-68600-41) PLUTONIUM ABSTRACTS. Volume 4, No. 7. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Aug. 1, 1964. Contract AT(45-1)-1350. 34p.

Information concerning new developments in plutonium technology is presented. Subject fields reviewed include Biology and Medicine, Chemistry, Metallurgy and Ceramics, Physics, Reactor Technology, and Miscellaneous. (J.R.D.)

40975 (IS-883) BASE HYDROLYSIS OF TRANS-DICHLORODIAMMINEPLATINUM(II). Ronald George Gunther and D. S. Martin (Ames Lab., Ames, Iowa). Feb. 1964. Contract W-7405-eng-82. 56p.

The reactions $\underline{t}$ – $[Pt(NH_3)_2Cl_2]$ + OH^- → $\underline{t}$ – $[Pt(NH_3)_2Cl(OH)]$ + Cl^- and $\underline{t}$ – $[Pt(NH_3)_2Cl(OH)]$ + OH^- → $\underline{t}$ – $[Pt(NH_3)_2(OH)_2]$ + Cl^- in aqueous solutions were studied by measuring the changes in specific conductivity and in ultraviolet absorption which occurred during the course of the reactions. The rates of reaction were determined from a plot of ln L(t) vs time, where L(t) is either (optical density at infinite time) – (optical density at time t) for the spectrophotometric determinations or (conductivity at time t) – (conductivity at infinite time) for the conductometric experiments. The conductometric experiments also required correction for hydroxide attack upon the measuring vessel. Both reactions were found to be zero order in hydroxide, to be the only reactions occurring between the platinum complex and the hydroxide for times up to one day, and to involve the formation of an aquo intermediate. The rates for the first hydrolysis were 6.21×10^{-5} sec^{-1} at 20°C, 10.6×10^{-5} sec^{-1} at 25°C, and 29.3×10^{-5} sec^{-1} at 35°C, with an energy of activation of 18.0 kcal and an entropy of activation of –16 cal/°K. The rates for the second hydrolysis were 0.17×10^{-5} sec^{-1} at 25°C and 0.50×10^{-5} sec^{-1} at 35°C, with an energy activation of 19.1 kcal and an entropy of activation of –21 cal/°K. (auth)

40976 (IS-893) POGO—PSAG MANUAL. D. R. Fitzwater, E. H. Hietbrink, M. M. Ledet, D. E. McFarland, and C. E. Runge (Ames Lab., Ames, Iowa). May 1964. Contract W-7405-eng-82. 85p.

The problem considered is the design and structure of the POGO monitor. The programs comprising the monitor and the necessary modifications to the compiler systems tape are discussed. Flow charts accompany the writeups. (auth)

40977 (LA-DC-6017) MINI-CAM TRACER PLATE—A DEVICE TO MINIMIZE THE USE OF CAMS FOR CONTROLLING A TRACER LATHE. Edward J. Sass (Los Alamos Scientific Lab., N. Mex.). [nd]. Contract [W-7405-eng-36]. 25p.

The Mini-Cam Tracer Plate is a device for controlling a tracer lathe in the generation of various radii tangent angle configurations. These configurations can be generated to precise tolerances by the simple adjustment of a pivoted tracer arm assembly by means of gage blocks. The tracer plate can be used without a cam, and with a cam for machining more complex shapes. (D.L.C.)

40978 (LADC-6347) PROBING EXPERIMENTS ON PRESSURE OSCILLATIONS IN TWO-PHASE AND SUPERCRITICAL HYDROGEN WITH FORCED-CONVECTION HEAT TRANSFER. R. S. Thurston (Los Alamos Scientific Lab., N. Mex.). [1964]. Contract [W-7405-eng-36]. 35p. (CONF-554-6)

From Cryogenic Engineering Conference, Philadelphia, Aug. 1964.

Pressure oscillations induced by forced convection heat transfer to liquid hydrogen have been probed using a test section which cooled from ambient to liquid hydrogen temperatures during the course of a run. Acoustic modes due to Helmholtz and open-open pipe resonances were observed at sub and supercritical pressures. These modes did not develop when the inlet hydrogen was superheated. Pressure fluctuations in the form of sawteeth, negative pulses, and beats were also observed above and below the critical pressure. A mode which primarily occurred above the critical pressure was observed. One associated with subcritical two phase flow was also observed. Experimental evidence indicated that heat transfer at low flow rates was substantially better in two-phase flow than in supercritical flow, that at moderate flow rates the pressure drop increased after the outlet hydrogen temperature leveled off at a minimum, and that larger axial wall temperature gradients were obtained in slow cooldowns than in fast ones. (auth)

40979 (LADC-6410) EXPERIMENTAL STUDY OF H_2O-LH_2 AND H_2O-LN_2 HEAT EXCHANGERS. K. D. Williamson, Jr., and J. R. Bartlit (Los Alamos Scientific Lab., N. Mex.). [nd]. Contract [W-7405-eng-36]. 22p. (CONF-554-7)

From Cryogenic Engineering Conference, Philadelphia, Aug. 1964.

A study was made of heat transfer coefficients and ice formation during the steady-state operation of countercurrent H_2O-LH_2 and H_2O-LN_2 heat exchangers. The cryogen flowed through a 1-in. OD (0.064-in. wall), 347 stainless steel tube while the water flowed through the annulus between the inner tube and the $1\frac{1}{2}$-in. ID Plexiglas outer tube. Flow rates were 3250 to 10,400 lb/hr for water, 227 to 778 lb/hr for hydrogen, and 1820 to 7000 lb/hr for nitrogen. Pressures ranged from 50 to 150 psia. The inlet water temperature ranged from 565 to 594°R while the bulk outlet water temperature approached the ice point. Hydrogen outlet temperatures ranged from 300 to 507°R while the nitrogen temperatures never exceeded the saturation temperature at the pressures involved. The experimental hydrogen heat transfer coefficients were $\frac{1}{2}$ to $\frac{1}{9}$ of those predicted by the Dittus-Boelter equation. The experimental two-phase nitrogen coefficients were $\frac{1}{4}$ to $\frac{1}{26}$ of the theoretical single-phase gas coefficients. A stable layer of ice formed during the hydrogen runs while ice was essentially absent during the nitrogen runs. Substantial pressure oscillations were observed during the hydrogen runs but none were seen during the nitrogen runs. It was concluded that the use of water as a heat exchange medium to cryogenic fluids presents no new operating difficulties. (auth)

40980 (LADC-6411) THE COMPRESSIBILITY OF PERLITE. J. K. Novak (Los Alamos Scientific Lab., N. Mex.). [nd]. Contract [W-7405-eng-36]. 23p. (CONF-554-3)

From Cryogenic Engineering Conference, Philadelphia, Aug. 1964.

The possibility of compaction of insulation due to thermal cycling has become a problem for designers of large perlite insulated dewars. A qualitative study of perlite fluidity was done, and the results indicated that perlite insulation will compact rather than flow. A model was proposed for describing this compaction. Measurements were made of the pressure required to compress perlite in closed cylinders, and these results were applied to the compaction model to calculate an upper limit on the forces and pressures to be expected in large perlite insulated dewars as a function of the number of thermal cycles experienced. (auth)

40981 (LADC-6412) PRESSURIZATION ANALYSIS OF A LARGE-SCALE LIQUID HYDROGEN DEWAR. D. H. Liebenberg and F. J. Edeskuty (Los Alamos Scientific Lab., N. Mex.). Contract [W-7405-eng-36]. 23p. (CONF-554-4)

From Cryogenic Engineering Conference, Philadelphia, Aug. 1964.

A 50,000-gallon evacuated perlite dewar contains instrumentation including a capacitance gage for level measurement and a series of 27 platinum resistors for temperature measurement in liquid and ullage spaces. Gas quantities for pressurization are metered through an orifice. Pressurization has been accomplished by letting the dewar self-pressurize or by controlled flows of high pressure hydrogen gas which enters the dewar through a diffuser. During self-pressurization a typical rate of pressure rise is 0.53 psia/hr due to the low heat leak. Observations indicate the formation of a warm layer near the liquid surface in qualitative agreement with several models suggested for this phenomena. For both self-pressurization and hydrogen gas pressurization, a mass transfer from the liquid to vapor at the interface is inferred from the data. Various sources of error in the experiments are dealt with and their effect on the conclusions stated. (auth)

40982 (MLM-1189) SHOCK TUBES: A BIBLIOGRAPHY. Arnold M. Melnick (Mound Lab., Miamisburg, Ohio). Mar. 10, 1964. Contract AT(33-1)-Gen-53. 55p.

A total of 667 references is presented from literature dealing with the application of shock tubes to chemistry and physics and covering the period from 1946 through March 1963. Author and subject indexes are given. (D.L.C.)

40983 (MLM-1211) EVALUATION OF THERMOSETTING PLASTIC MOLDING POWDERS WITH A CAPILLARY EXTRUSION RHEOMETER. J. W. Heyd, R. M. Brodbeck, L. E. Brown, and L. W. Hartzel (Mound Lab., Miamisburg, Ohio). July 21, 1964. Contract AT(33-1)-Gen-53. 14p.

A capillary extrusion rheometer was used with an In-

stron Testing Machine to measure the flow properties of an asbestos-filled diallyl phthalate molding powder. Variations in extrusion characteristics caused by different reaction temperatures, die orifices, crosshead speeds, catalyst concentrations, and inhibitor concentrations were readily detected by the instrument. The flow properties of 20 commercial thermosetting molding powders were measured. The rheometer discriminates readily between hard and soft modifications of plastic materials with a precision of about 1%. These initial tests indicated that the rheometer might be an acceptable replacement for the present ASTM Mold Index Test for evaluating thermosetting plastics. (auth)

40984 (NAA-SR-Memo-9560) DYNAMIC LOADS ANALYSIS FOR LAUNCHING A MISSILE IN A WIND. R. D. Galletly (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Feb. 24, 1964. Contract [AT(11-1)-Gen-8]. 56p.

Rapidly applied external forces may arise from many sources during the launching and flight of a missile. One of the most important disturbing forces is that produced by wind gust immediately after lift-off. Two missile configurations were considered; one configuration consists of a payload 402.2 in. in length with a concentrated weight of 2300 lbs, and the other configuration incorporates a payload 1135.8-in. long and a concentrated weight at the tip of 2530 lbs. Both are connected to a suitable booster and second stage vehicle. The equations of motion of an elastic missile subjected to suddenly applied loads are formulated and their solution indicated. The results yield shear and bending moment distributions for the assumed steady-state ground wind profile. (auth)

40985 (NP-14220) UNITED KINGDOM ATOMIC ENERGY AUTHORITY TENTH ANNUAL REPORT, APRIL 1, 1963–MARCH 31, 1964. (United Kingdom Atomic Energy Authority, London). 97p.

The tenth annual report of the United Kingdom Atomic Energy Authority contains information on research programs, membership, finance and accounts, production and processing plants, reactor development, nuclear weapons and test detection, health and safety, information services, commercial operations and raw materials, international relations, functions of authority establishments, and list of reactors. The research programs discussed pertain to chemistry, plasma physics, fusion physics, metallurgy, radiation effects, fuel development, nuclear chemistry, instrumentation, and various other programs related to atomic energy development. (N.W.R.)

40986 (NP-14292) BIBLIOGRAPHY ON ELECTRON PROBE MICROANALYSIS AND RELATED SUBJECTS. Kurt F. J. Heinrich (Du Pont de Nemours (E. I.) & Co. Pigments Dept., Wilmington, Del.). Oct. 1961. First Revision, Oct. 1962, Second Revision, Oct. 1963. 158p.

A large number of references is presented under the following headings: electron optics, light optics, target phenomena, x-ray measurement, electron probe analyzer, applications, sample preparation, and related subjects. An author index is included. (D.L.C.)

40987 (NP-14335) SPECIAL SUMMARY REPORT ON THE EVALUATION OF GAMMA-RAY SPECTRAL STUDIES AND SUBSURFACE GAS ANALYSES AS ON-SITE INSPECTION METHODS. D. F. Saunders, A. E. Purvis, and D. A. Tarver (Texas Instruments, Inc., Dallas). Apr. 1, 1962. 38p.

Results are reported of field tests of gamma spectral measurements and subsurface gas analyses over the sites of several buried nuclear explosions. The results indicate that $^{95}Zr-^{95}Nb$ in explosions with minor venting and ^{127}Xe in shallow subsurface gases of nonventing explosions should be useful in identifying and dating these explosions. (D.L.C.)

40988 (NRL-6053) THE PRESENT STATUS OF CHEMICAL RESEARCH IN ATMOSPHERE PURIFICATION AND CONTROL ON NUCLEAR-POWERED SUBMARINES. Third Annual Progress Report. H. W. Carhart and V. R. Piatt, eds. (Naval Research Lab., Washington, D. C.). Dec. 31, 1963. 67p. (AD-435518)

Considerable progress was made in developing: the sulfate-cycle system for the electrolytic generation of oxygen from water and the absorption of carbon dioxide, additives to decrease the degradation of monoethanolamine (MEA) in the CO_2 scrubber, and improved methods of sampling and analysis of atmospheres. Other topics covered include the use of algae for oxygen production and carbon dioxide absorption, an assessment of CO_2 removal systems, and catalytic combustion studies using hopcalite. (auth)

40989 (ONR-16(Vol.1)) SOLUTION TO NAVY PROBLEMS THROUGH ADVANCED TECHNOLOGY. The Seventh Navy Science Symposium, May 14, 15, 16, 1963, Pensacola, Florida. (Office of Naval Research, Washington, D. C.). 338p. (AD-421708)

Sixteen papers are presented on the following topics: intermetallic compounds, quality control, acceleration effects on pilot performance, impact behavior of metals, calorobic inorganic-organic polymers, radiochemical studies of fallout, sonar projectors, spectra of rare earth ions, microwave amplifiers, radiation effects on Si, glass-reinforced plastic structures, hydromagnetic wave propagation, etc. Separate abstracts were prepared for the three papers on the radiochemical studies of fallout, spectra of rare earth ions, and radiation effects on Si. (D.L.C.)

For abstracts of individual papers see: 39165, 39282, and 40005.

40990 (ORNL-IIC-1) PUBLICATIONS ON ISOTOPES AT OAK RIDGE NATIONAL LABORATORY, 1946–1963. Robert H. Lafferty, Jr., P. S. Baker, and Martha Gerrard (Oak Ridge National Lab., Tenn.). Contract W-7405-eng-26. 312p.

Almost 1700 references to work done with both stable and radioactive isotopes at Oak Ridge National Laboratory have been collected from journal and report literature. These references are arranged under fourteen subject headings, and key word, author, isotope, and report number indexes are provided. (auth)

40991 (RME-4581) URANIUM IN PERU. John W. Gabelman and Raymond R. Beard (Division of Raw Materials, AEC and Peru. Junta de Control de Energía Atomica, Lima). Jan. 1, 1962. 158p.

Results are presented of a joint U. S.-Peru uranium exploration program which was conducted from 1953 through 1960. Investigation of the known metal mines and prospects did not result in the discovery of economic U deposits. Areal studies of favorable environments such as host rocks, shales, etc., also gave negligible results. A study of the hydrothermal mineralization cycle revealed anomalous radioactivity in the low-temperature areas, and it is believed that the lowest temperature zones in the eastern Andes offers the best possibilities for economic U deposits in Peru. (D.L.C.)

40992 (SC-R-64-198) ELEMENTARY RELIABILITY TECHNOLOGY. F. W. Muller (Sandia Corp., Albuquerque, N. Mex.). July 1964. Contract [AT)29-1)-789]. 133p. Sandia Corp. Monograph.

The classification of system behavior as discrete or continuous is discussed. Probability equation are developed for each classification. (D.L.C.)

40993 (TID-21018) A NOTE ON INVERTED CENTERS OF PRESSURE AND CROSSED MASS POINTS IN A TWO-DIMENSIONAL HYDRODYNAMICS CALCULATION. Leroy Amunrud and S. Robert Orr (Los Alamos Scientific Lab., N. Mex.). May 26, 1958. Contract W-7405-eng-36. 16p.

A mathematical method for keeping mass points from crossing is developed for a rectangular mesh. (R.E.U.)

40994 (TID-21052) PROJECT ON ANISOTROPIC DIFFUSION AND ELECTROMIGRATION. Annual Report, December 1, 1963–November 30, 1964. H. B. Huntington (Rensselaer Polytechnic Inst., Troy, N. Y.). Aug. 1964. Contract AT(30-1)-1044. 6p.

Electromigration studies were conducted during the period using Co and Ag. The prediction that Co mass transport would be directed toward the cathode was confirmed. Motion of Ag was toward the anode. Observations concerning void formation in Ag are included. Plans for study of atomic movement in bcc refractory metals are discussed. In other work the diffusion of radioactive Ga, Cu, and Fe in Zn was investigated. (J.R.D.)

40995 (UCSD-64-01) DESIGN AND IMPLEMENTATION OF A GENERAL-PURPOSE INPUT ROUTINE. A. Hassitt (California. Univ., San Diego, La Jolla). Jan. 1964. Contract AT-Gen-10(11-1). 16p.

The problem of getting data and control information in manuscript form into computers is considered. Design criteria are given for an input routine that is easy to use, reads all types of data, and reads correctly anything that can be read by the human eye. A user's description is given of a Fortran implementation of such a routine, and some of its uses are described. Finally, the routine itself is given, written in the CDC Fortran-63 language using a decision matrix. (D.L.C.)

40996 (USNRDL-TR-752) SOLUTE DISTRIBUTION IN THE $Na_2O-B_2O_3-NaCl$ SYSTEM. III. IMMISCIBILITY DIAGRAMS OF MOLTEN SODIUM HALIDE–SODIUM POLYBORATES. B. L. Dunicz and R. C. Scheidt (Naval Radiological Defense Lab., San Francisco). May 22, 1964. Contract AT(49-2)-1167. 42p.

Immiscibility isotherms were obtained for the systems: boron oxide–sodium metaborate–sodium chloride at 810°C and 980°C, and boron oxide–sodium metaborate–sodium bromide and sodium iodide at 800°C and 980°C. Varied mixtures of the components were equilibrated at constant temperature in graphite crucibles sealed in silica glass tubes under vacuum. The immiscibility areas formed between the two conjugate liquid phases increase with the atomic number of the halide. For the same halide, however, those areas are only slightly affected by the changes in temperature. In the systems studied, the components appear to combine in definite stoichiometric relationships. (auth)

40997 (WAPD-T-1604(Rev.)) THE PEACEMAN-RACHFORD METHOD FOR SMALL MESH INCREMENTS. Willis H. Guilinger, Jr. (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Oct. 1963. Contract AT(11-1)-Gen-14. 25p.

The Peaceman-Rachford method is an iterative technique used for solving elliptic differential equations. It is proved for the differential equation given in any convex polygon where the mesh is consistent with the polygon, that the number of iterations needed to approximate a finite difference solution is bounded and independent of the size of the mesh increments. (D.L.C.)

40998 (WIS-AEC-30(Pt.I)) THE ENERGY OF INTERACTION OF GROUND- AND EXCITED-STATE HYDROGEN ATOMS. PART I. Series 3, Pages 1-182. Paul Edward Cade (Wisconsin. Univ., Madison. Theoretical Chemistry Lab.). June 19, 1961. Contract AT(11-1)-298. 190p.

Calculation results for a number of internuclear separations, for all of the potential energy curves which arise from the interactions of two H atoms, either being in a 1s, 2s, or 2pσ state are reported. As trial wave functions for each molecular symmetry all of the valence bond functions which can be built from 1s, 2s, and 2pσ atomic orbitals centered on the two nuclei are used. The potential energy curves which are considered are thus those of the lowest six $^1\Sigma_g$, the lowest six $^3\Sigma_u$, the lowest three $^1\Sigma_u$, and the lowest three $^3\Sigma_g$ molecular states. Particular attention is devoted to a study of any humps or dips in the resulting potential energy curves. Two parallel calculations were made which differed only in the use of a nodal 2s orbital in one and a nodeless 2s orbital in the other. A study of the effect of this nodal or nodeless character was also made. The effect of the virial theorem scaling on the potential energy curves and on the various humps and dips was also considered. A full listing of the necessary molecular integrals, the various matrix elements formed from them, and the calculated eigenvectors and eigenvalues for each of the various states is given. A review of contemporary problems in the study of intermolecular forces is included. (auth)

40999 (WIS-AEC-30(Pt.II)) THE ENERGY OF INTERACTION OF GROUND- AND EXCITED-STATE HYDROGEN ATOMS. PART II. Series 3, Pages 183-411. Paul Edward Cade (Wisconsin. Univ., Madison. Theoretical Chemistry Lab.). June 19, 1961. Contract AT(11-1)-298. 231p.

A discussion is given of the generalizability of the methods employed in this research and a detailed analysis of a variety of different H molecule wave functions is presented. The comparative analysis of the various molecular wave functions of H_2 is presented to relate the various concepts of electron correlation at small internuclear separations to those of polarizability at large and intermediate internuclear separations. (auth)

41000 PROCEEDINGS OF THE SYMPOSIUM ON ISOTOPE MASS EFFECTS IN CHEMISTRY AND BIOLOGY HELD IN VIENNA, AUSTRIA 9-13 DECEMBER, 1963. N. Grell, ed. Pure Appl. Chem., 8: 215-562(1964). London, Butterworths, 1964. (CONF-269)

Twenty-nine articles are included; separate abstracts were prepared for 15. The remaining 14 articles on theory and interpretation of isotope effects and investigations of isotope effects in organic systems, biochemical systems, and biological systems, were previously abstracted in NSA as: 18: 123, 1728, 6784, 6839, 8098, 8316, 8391, 8402, 8403, 8404, 8529, 10136, 10137, and 10138. (P.C.H.)

For abstracts of individual papers see: 38763, 38764, 38765, 39113, 39238, 39239, 39240, 39241, 39242, 39243, 39244, 39245, 39246, 39341, and 39342.

41001 ACTIVITIES OF TOSHIBA IN ATOMIC ENERGY FIELD. Hiroshi Kamogawa (Tokyo Shibaura Electric Co., Ltd.). Toshiba Rev., Intern. Ed., No. 18, 42-8(1964).

Activities of Toshiba in utilization of radioisotopes, development of particle accelerators and their applica-

tions, manufacture of nuclear instruments and radiation dosimeters, reactor development, research on reactor engineering and nuclear fuel, and thermonuclear fusion research are discussed. (M.C.G.)

41002 CANADA—A NUCLEAR POWER PLANT SUPPLIER. J. L. Gray (Atomic Energy of Canada Ltd., Chalk River, Ont.). Toronto, Canadian Nuclear Assn., 1964, Preprint 64-CNA-115, 14p. (CONF-539-12)

From Canadian Nuclear Association Conference on Canada's Role in a World of Expanding Nuclear Industry, Toronto, May 1964.

The Canadian experience and program for reactor development, as well as domestic and foreign sales and construction, are reviewed. (T.F.H.)

41003 U. S. INDUSTRIAL PARTICIPATION IN NUCLEAR ENERGY. Ernest B. Tremmel (Atomic Energy Commission, Washington, D. C.). Toronto, Canadian Nuclear Assn., 1964, Preprint 64-CNA-114, 15p. (CONF-539-11)

From Canadian Nuclear Association Conference on Canada's Role in a World of Expanding Nuclear Industry, Toronto, May 1964.

An outline is presented of the present and future cooperation between the U.S. AEC and private nuclear industry. (T.F.H.)

41004 PANEL DISCUSSION—RESEARCH AND DEVELOPMENT BRIEF FOR INDUSTRY AND GOVERNMENT. Toronto, Canadian Nuclear Assn., 1964, Preprint 64-CNA-123, 10p. (CONF-539-16)

From Canadian Nuclear Association Conference on Canada's Role in a World of Expanding Nuclear Industry, Toronto, May 1964.

A panel discussion on the state of preparedness of Canadian industry for designing and producing CANDU-type reactors is presented. The particular areas of inquiry include heavy water production, reactor safety experience, reactor components and materials design and production, and fuel design and production. It is concluded that Canadian industry is more advanced in the production than in the design of power reactors. (T.F.H.)

41005 NUCLEAR GENERATION IN CANADA 1965-1985. Toronto, Canadian Nuclear Assn., 1964, Preprint 64-CNA-110, 51p. (CONF-539-8)

From Canadian Nuclear Association Conference on Canada's Role in a World of Expanding Nuclear Industry, Toronto, May 1964.

A reasonable estimate of the nuclear plant capacity likely to be installed in Canada during the next 20 years, and the attendant nuclear fuel requirements, are established. It is considered that the foregoing can best be achieved by an appraisal of the following related factors: the extent, location, and relative cost of electric energy production from fossil fuels and hydraulic resources for various provinces or regions; the current and probable future cost of electrical energy produced by large nuclear stations; and provincial and regional generation expansion plans as presently envisaged by the utilities, particularly with respect to major river basin developments. (auth)

41006 RESEARCH AND DEVELOPMENT BRIEF FOR INDUSTRY AND GOVERNMENT. RESEARCH AND DEVELOPMENT ACTIVITY TO IMPROVE CANADIAN INDUSTRIAL CAPABILITY TO DESIGN AND SUPPLY NUCLEAR POWER SYSTEMS OF THE HEAVY WATER CONCEPT. ([AECL] Reactor Technology Committee—Research and Development Sub-Committee). Toronto, Canadian Nuclear Assn., 1964, Preprint 64-CNA-101, 28p. (CONF-539-6)

From Canadian Nuclear Association Conference on Canada's Role in a World of Expanding Nuclear Industry, Toronto, May 1964.

This brief has presented the views and thoughts on research and development of the R and O Sub-Committee of the Canadian Nuclear Association. Recommendations are directed towards members of the CNA, other industrial groups and firms, and the various governments concerned. These recommendations will contribute to the increasing growth and stability of the Canadian nuclear industry and to the increasing good of the public sector through more efficient, safe, and economic use of nuclear energy in Canada. (auth)

41007 NUCLEAR POWER DEVELOPMENT IN CANADA AND OTHER COUNTRIES. W. B. Lewis (Atomic Energy of Canada Ltd., Chalk River, Ont.). Toronto, Canadian Nuclear Assn., 1964, Preprint 64-CNA-119, 16p. (CONF-539-15)

From Canadian Nuclear Association Conference on Canada's Role in a World of Expanding Nuclear Industry, Toronto, May 1964.

For the near term future it is becoming increasingly difficult to bring in a new type of reactor to compete. Because the capital cost is high, a great advantage lies with those types that have been through the development and prototype stage. Once these have reached the competitive level, the construction of successive reactors with possibly some increase in generating capacity, will bring great cost reductions. The gas-cooled graphite-moderated, water-cooled-and-moderated, and heavy-water-moderated reactors at present hold the stage and all promise further cost reduction. In the longer term it becomes necessary to supplement those reactor types that have poor neutron economy and are not able to use plutonium as a fuel competitively. For this reason the reactors that can at once or without major change adopt the uranium-thorium cycle to achieve an energy yield of 50 Mwd/kg U or more while remaining competitive, have more promise for the long term. The CANDU type is especially promising, but others may very well compete. In the very long term, when the price of uranium rises because low-cost ores become exhausted, only the fast breeders and reactors on the uranium-thorium cycle seem likely to remain competitive. The fast breeders still face technical problems that affect their chances of competing. Should the price of uranium ever rise as high as \$250/kg U (\$100/lb U_3O_8), the cost of U-235 would be about \$55/g and other separated fissile materials would have comparable value. It is not at all impossible that other methods of producing U-233 or Pu-239 from thorium and uranium by other nuclear reactions may be competitive and limit the demand for uranium. (auth)

41008 EQUIPMENT, MATERIALS AND SERVICES TO MEET THE C.N.A. NUCLEAR POWER FORECAST. S. H. Dowdell. Toronto, Canadian Nuclear Assn., 1964, Preprint 64-CNA-111, 11p. (CONF-539-9)

From Canadian Nuclear Association Conference on Canada's Role in a World of Expanding Nuclear Industry, Toronto, May 1964.

Canadian demands for nuclear power during the period 1970 to 1985 may require expenditures totalling 3.5 billion. Beginning at somewhat over \$100 million per year, spending for nuclear power facilities should rise during the forecast period to establish an average annual rate of \$235 million. (auth)

CORPORATE AUTHOR INDEX

This index contains entries for this period for all report literature and, in addition, for certain published literature items for which it is felt that a corporate approach is especially desirable, e.g., symposia, conference proceedings, and meetings.

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Because of problems involving the mechanical preparation of this index, all accent marks are omitted. The following changes in spelling have been introduced to reduce some of the confusion which might result from omitting the accents:

ä	becomes	ae
ö		oe
ø		oe
ü		ue (except in transliterated Chinese names)

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SUBJECT INDEX

Main entries in this index are generally specific materials, things, and processes. These are followed by modifiers that describe the properties of, and processes applied to, the main entries.

The number preceding the colon is the *NSA* volume number, and the number following is the abstract number. The designation (R) following the abstract number indicates that the abstract is of a progress report; (P) indicates a patent; and (T) indicates a translation. Abstracts for reports other than progress reports carry no letter designation. References to report numbers, where appropriate, are included after the abstract number of the citation. Published literature (journal article or book) is indentifiable by the absence of a report number.

General Indexing Style

The user should bear in mind that the ideas presented in the original literature, rather than key words, have been indexed. The indexers have tried to select what seemed the most probable and logical place to look for typical information. Since it is not possible to anticipate where a user would look for information, numerous cross references are included to assist him in his search.

Experience in using an index of this type will be the best guide in obtaining the desired information, and a consideration of synonymous or closely related terms will prove valuable.

Information must be so indexed as to be of the greatest use to the greatest number of users. This requires that a topic be indexed to headings that most specifically describe it and not ordinarily to the headings that describe its ultimate use, nor to the general class headings that include the specific headings. For example, information on the treatment of thyroid disease with I-131 would be indexed under Thyroid Diseases and under Iodine Isotopes I-131, but not necessarily under Radiotherapy. A study of the effects of x radiation on hair would be indexed under both X Radiation and Hair. However, the information would not be indexed under the experimental animal, e.g., Rats, unless the report discusses the effects on rat hair as compared with the effect on the hair of other animals.

The broad, general class headings are used only for general information or for comprehensive reports or articles.

Subject Heading Styles

Generally, the direct form of subject entry is used rather than inverted headings or, in some cases, subheadings; e.g., Amino Acids rather than Acids, amino; Helium Isotopes He-4 rather than Helium—isotopes He-4 or Helium—He-4 isotopes. Note, however, that in some cases modifying terms are used parenthetically in preference to a more direct type of entry which would result in the scattering of information. Organic compounds, however, are usually entered in the index in the inverted form so that substituted compounds can be listed near the parent compound; e.g., Benzene, Bromo- rather than Bromobenzene. In general, the style of nomenclature used is that of *Chemical Abstracts*, except that some items listed in that publication as subheadings are elevated to form part of the main heading; e.g., Butyric Acid, Methyl Ester rather than Butyric Acid—methyl ester.

Alphabetization

Main headings are arranged according to the widely accepted word-by-word alphabetic system. A parenthetic qualifier following a main heading is disregarded in alphabetizing unless there are two or more headings identical except for the parenthetic qualifier, in which case the qualifier determines the order. Headings involving Greek letters are arranged as if the names of the letters were spelled out, e.g., Mesons (π), Mesons (ξ).

Nomenclature of Inorganic Compounds

Inorganic compounds are indexed in the direct form, listing cations in the order of increasing valence in the case of polycationic salts of varying valence and in alphabetic order for polycationic salts in which all cations have the same valence; e.g., Sodium Aluminum Silicates and Potassium Sodium Sulfates.

Multicomponent Systems

Multicomponent alloys, except well-known trade names are indexed under each element in the alloy.

Example: Aluminum–Chromium Alloys are indexed

ALUMINUM ALLOYS
Al–Cr ...
CHROMIUM ALLOYS
Al–Cr ...

Well-known alloys such as Hastelloy are indexed directly with cross references under the element components. Multicomponent systems of elements are indexed similarly.

Example: Silicon–Tungsten Systems are indexed

SILICON SYSTEMS
Si–W ...
TUNGSTEN SYSTEMS
Si–W ...

Multicomponent systems of compounds are similarly indexed under the compound.

Physical States of Materials

In this subject index specification of the physical state of the material, if other than normal, is included in the modifying phrase.

Modifying Phrases (Subheadings)

Descriptive phrases (modifiers), rather than ordinary subheadings, are used under the main headings to give a better indication of the material covered in an abstract than would be possible with only a word or two whenever it appears that such information would be useful. Such phrases are written so that the idea considered most important is presented first, should a not-too-awkward expression result. However, when using this index, the reader is advised to scan all modifiers under a main heading to determine whether any abstracts in addition to the most obvious should be consulted for the desired information. Many of the modifiers are designed to be read in inverted order or to be read with the main heading inserted at the position of the comma in order to obtain a meaningful phrase; e.g., Uranium—allotropic transformation temperatures of, effect of cooling rate on is read "effect of cooling rate on allotropic transformation temperatures of uranium." In many cases, the prepositions have been omitted from such phrases provided no ambiguity results from the omission.

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AEEW-R–	**(British)**	
206	18-39788	Dep.(mn)
303	18-39609	Dep. Health Phys., 10: 679-84(1964)
AERE-M–	**(British)**	
1364	18-39943	J. Sci. Instr., 41: 504-5(1964)
1410	18-39564	Dep.; $0.50(BIS), 2s. 6d. (HMSO)
AERE-R–	**(British)**	
3360	18-39610	Dep.; $0.60(BIS), 3s. (HMSO)
4413	18-38731	"Biological Effects of Neutron and Proton Irradiations. Vol. I." Vienna, International Atomic Energy Agency, 1964
4474	18-39056	Dep.; $1.10(BIS), 5s. 6d. (HMSO)
AERE-Trans–	**(British)**	
1005	18-39053	Dep.; $0.60(BIS), 3s. (HMSO)
AFCRL–	**(Non-AEC)**	
64-67	18-40654	$2.75(OTS)
64-199	18-39883	$0.50(OTS)
64-395	18-40174	$0.75(OTS)
64-412	18-40655	$0.75(OTS)
ANL–		
6435	18-39884	Dep.; $4.00(cy), 2(mn) OTS
6757	18-39806	Dep.; $1.00(cy), 1(mn) OTS
6831	18-39363	Dep.; $2.00(cy), 1(mn) OTS
6847	18-40779	Dep.; $3.00(cy), 1(mn) OTS
6874	18-39364	Dep.; $2.00(cy), 1(mn) OTS
6882	18-39402	Dep.; $2.00(cy), 1(mn) OTS
6886	18-40502	Dep.; $4.00(cy), 2(mn) OTS
6887	18-38736	Dep.; $1.00(cy), 1(mn) OTS
6888	18-39789	Dep.; $1.00(cy), 1(mn) OTS
APCI–		
541102	18-39410	Dep.(mn); $3.00(cy), 1(mn) OTS
541103	18-39411	Dep.(mn); $3.00(cy), 2(mn) OTS
APED–	**(Misc.)**	
4285	18-40821	
4342	18-40466	
4463	18-40822	
4522	18-39528	
4564	18-40747	
APL-TDR–	**(Non-AEC)**	
64-92	18-40214	OTS
ASD-TDR–	**(Non-AEC)**	
62-509(Vol.V)	18-39885	OTS
AWRE-O–	**(British)**	
36/64	18-39886	Dep.(mc)
BAW–	**(Misc.)**	
164	18-40823	Dep.(mn); $1.00(cy), 1(mn) OTS
208	18-40941	Dep.(mn); $4.00(cy), 2(mn) OTS
1187	18-40924	Dep.(mn); $1.00(cy), 1(mn) OTS
BKI–	**(Yugoslavian)**	
5	18-39275	Dep.(mc)

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BLG–	**(Belgian)**	
240	18-38987	Rev. Franc. Etudes Clin. Biol., 8: 923-6(1963)
BM-RI–	**(Misc.)**	
6362	18-39807	Free(Bureau of Mines)
6503	18-39887	Dep.(mn) $1.00(cy), 1(mn) OTS
6507	18-39808	Dep.(mn); $2.00(cy), 1(mn) OTS
6509	18-39854	Dep.(mn); $2.00(cy), 1(mn) OTS
6515	18-39888	Dep.(mn); $1.00(cy), 1(mn) OTS
6518	18-39889	Free(Bureau of Mines)
6521	18-39890	Dep.(mn); $1.00(cy), 1(mn) OTS
BMI–	**(Misc.)**	
1673	18-39891	Dep.; $1.00(cy), 1(mn) OTS
1674(Del.)	18-40970	Dep.; $1.00(OTS)
1676	18-40824	Dep.(mn); $3.00(cy), 2(mn) OTS
1685	18-39892	Dep.; $2.00(cy), 1(mn) OTS
1686	18-39893	Dep.; $1.00(cy), 1(mn) OTS
1688	18-40044	Dep.; $2.00(cy), 1(mn) OTS
BMI-X–		
290	18-39988	Dep.(mn); $3.00(cy), 2(mn) OTS
BNL–		
876	18-39611	Dep.; $2.00(cy), 1(mn) OTS
7350	18-40045	Dep.(mn); $1.00(cy), 1(mn) OTS
7390	18-39425	Dep.(mn); $2.00(cy), 1(mn) OTS
7580	18-39134	Z. Anal. Chem., 204: 112-17(1964)
7597	18-38887	Radiation Res., 23: 19-25(1964)
7619	18-39241	Pure Appl. Chem., 8: 325-38(1964)
7621	18-39238	Pure Appl. Chem., 8: 225-42(1964)
7666	18-40046	Dep.(mn); $1.00(cy), 1(mn) OTS
7683	18-40971	Dep.(mn); $1.00(cy), 1(mn) OTS
7696	18-39989	Dep.(mn); $1.00(cy), 1(mn) OTS
7842	18-40467	Dep.(mn); $1.00(cy), 1(mn) OTS
7947	18-39203	J. Am. Chem. Soc., 86: 3836-40(1964)
7973	18-40221	Dep.(mn); $1.00(cy), 1(mn) OTS
8038	18-39152	Dep.(mn); $1.00(cy), 1(mn) OTS
8039	18-39153	Dep.(mn); $1.00(cy), 1(mn) OTS
8057	18-39316	J. Am. Chem. Soc., 86: 3887-8(1964)
8074	18-40578	Phys. Rev., 136: B18-27(1964)
8123	18-40328	Phys. Rev. Letters, 13: 358-60(1964)
8188	18-39276	Dep.(mn); $1.00(cy), 1(mn) OTS
8230	18-40222	Dep.(mn); $1.00(cy), 1(mn) OTS
8231	18-40223	Dep.(mn); $1.00(cy), 1(mn) OTS
8232	18-40224	Dep.(mn); $1.00(cy), 1(mn) OTS
8233	18-40225	Dep.(mn); $1.00(cy), 1(mn) OTS
8234	18-40226	Dep.(mn); $1.00(cy), 1(mn) OTS
8235	18-40227	Dep.(mn); $1.00(cy), 1(mn) OTS
8237	18-40228	Dep.(mn); $1.00(cy), 1(mn) OTS
8239	18-40229	Dep.(mn); $1.00(cy), 1(mn) OTS
8240	18-40230	Dep.(mn); $1.00(cy), 1(mn) OTS
8241	18-40231	Dep.(mn); $1.00(cy), 1(mn) OTS
8242	18-40232	Dep.(mn); $1.00(cy), 1(mn) OTS
8249	18-39612	Dep.(mn); $1.00(cy), 1(mn) OTS
8254	18-40303	Phys. Rev. Letters, 12: 67-9(1964)
8264	18-39277	Dep.(mn); $1.00(cy), 1(mn) OTS
8281	18-40748	Dep.(mn); $1.00(cy), 1(mn) OTS
8390	18-40329	Phys. Rev. Letters, 13: 380-5(1964)
BRL–	**(Misc.)**	
1231	18-39403	Dep.(mn); $1.00(cy), 1(mn) OTS
CALT–		
221-3	18-40972	Dep.(mn); $4.00(cy), 2(mn) OTS
473-2	18-39809	Dep.(mn); $1.00(cy), 1(mn) OTS
CAPE–		
1036	18-39698	EM
1060	18-39595	EM
1078	18-39399	EM
1079	18-39703	EM
1086	18-39417	EM
1088	18-39699	EM
1094	18-39700	EM
1101	18-40938	EM
1111	18-39701	EM
1117	18-39594	EM
1123	18-39416	EM
1125	18-39877	EM
1136	18-39702	EM
CAR–		
882-6	18-40380	Dep.(mn); $1.00(cy), 1(mn) OTS
CERN–	**(European Organization for Nuclear Research)**	
64-35	18-40085	Dep.(mn)
CLM-Bib–	**(British)**	
5	18-40656	Dep.(mn); $1.00(BIS), 5s. (HMSO)
CLM-P–	**(British)**	
40	18-40706	Proc. Phys. Soc. (London), 84: 257-62 (1964)
CM–	**(Misc.)**	
1043	18-40653	See AD-600845
1047	18-40049	See NP-14232
CONF-67–	**(Health Physics Society 8th Annual Meeting, New York, June 1963)**	
38	18-39609	See AEEW-R-303
CONF-179–	**(American Chemical Society Radionuclidic Exchange on Soils, Minerals, and Resins, Philadelphia, Apr. 1964)**	
12	18-40773	ORINS. Gmelin, AED-CONF-64-033-28
CONF-243–	**(American Nuclear Society Conference on Problems of Operating Research and Power Reactors, Ottawa, Oct. 1963)**	
59	18-40940	See AEET/ROD/8
CONF-269	**18-41000**	**(International Atomic Energy Agency Symposium on Isotope Mass Effects in Chemistry and Biology, Vienna, Dec. 1963)**
CONF-303–	**(3rd International Conference on the Mössbauer Effect, Ithaca, New York, Sept. 1963)**	
18	18-40172	ORINS. Gmelin, AED-CONF-63-143-20
CONF-337–	**(International Conference on Radioactive Pollution of Gaseous Media, Saclay, France, Nov. 1963)**	
5	18-39529	Dep.(mn); $3.00(cy), 1(mn) OTS
6	18-40749	Dep.(mn); $1.00(cy), 1(mn) OTS
31	18-39705	ORINS
33	18-39704	ORINS
34	18-39146	ORINS
37	18-39562	ORINS
39	18-39147	ORINS
41	18-40040	Dep.(mn); $1.00(cy), 1(mn) OTS
42	18-40041	Dep.(mn); $2.00(cy), 1(mn) OTS
43	18-39485	Dep.(mn); $1.00(cy), 1(mn) OTS
44	18-39486	Dep.(mn); $2.00(cy), 1(mn) OTS
57	18-39563	ORINS
58	18-39561	ORINS
CONF-407–	**(Electro Chemical Society, Toronto, May 1964)**	
4	18-39603	ORINS. Gmelin, AED-CONF-64-060-12
5	18-40083	ORINS. Gmelin, AED-CONF-64-060-13
6	18-39421	ORINS. Gmelin, AED-CONF-64-060-9
CONF-417–	**(American Physical Society Meeting, Pasadena, Calif., Dec. 1963)**	
31	18-40503	Dep.(mn); $2.00(cy), 1(mn); Gmelin, AED-CONF-63-253-46 Phys. Rev., 136: B71-7(1964)
CONF-446–	**(American Nuclear Society 10th Annual Meeting, Philadelphia, June 1964)**	
12	18-40758	See WAPD-T-1663
13	18-40772	ORINS. Gmelin, AED-CONF-64-081-2
15	18-40801	ORINS. Gmelin, AED-CONF-64-081-6
16	18-39418	ORINS. Gmelin, AED-CONF-64-081-7
17	18-39461	ORINS. Gmelin, AED-CONF-64-081-8
18	18-40744	ORINS. Gmelin, AED-CONF-64-081-9
19	18-40917	ORINS. Gmelin, AED-CONF-64-081-10
20	18-40921	ORINS. Gmelin, AED-CONF-64-081-12
21	18-39462	ORINS. Gmelin, AED-CONF-64-081-13
22	18-40837	See LA-DC-6265

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23	18-40836	See LA-DC-6264
24	18-40467	See BNL-7842
26	18-39560	ORINS
27	18-40916	ORINS. Gmelin, AED-CONF-64-081-1
28	18-39361	ORINS
29	18-40799	ORINS. Gmelin, AED-CONF-64-081-39
30	18-39706	ORINS. Gmelin, AED-CONF-64-081-26
31	18-40745	ORINS. Gmelin, AED-CONF-64-081-25
32	18-40800	ORINS. Gmelin, AED-CONF-64-081-23
33	18-40939	ORINS. Gmelin, AED-CONF-64-081-38
36	18-40750	Dep.(mn); $2.00(cy), 1(mn); Gmelin, AED-CONF-64-081-24
38	18-40832	See GA-5377
CONF-452–	**(American Physical Society, Washington, D. C., Apr. 1964)**	
44	18-40093	See UCRL-11477
46	18-40170	ORINS. Gmelin, AED-CONF-64-044-71
47	18-40625	ORINS. Gmelin, AED-CONF-64-044-70
48	18-40377	ORINS. Gmelin, AED-CONF-64-044-69
52	18-40626	ORINS. Gmelin, AED-CONF-64-044-67
53	18-40378	ORINS. Gmelin, AED-CONF-64-044-72
55	18-40379	ORINS. Gmelin, AED-CONF-64-044-57
CONF-471–	**(American Physical Society 5th Annual Meeting, San Diego, Calif., Nov. 1963)**	
34	18-40657	Dep.(mn); $2.00(cy), 1(mn) OTS
38	18-39805	ORINS. Gmelin, AED-CONF-63-268-52
CONF-481–	**(American Physical Society Annual Meeting, New York, Jan. 1964)**	
75	18-40374	ORINS. Gmelin, AED-CONF-64-003-103
76	18-40375	ORINS. Gmelin, AED-CONF-64-003-100
77	18-40376	ORINS. Gmelin, AED-CONF-64-003-109
78	18-40628	ORINS. Gmelin, AED-CONF-64-003-98
79	18-40627	ORINS. Gmelin, AED-CONF-64-003-99
80	18-40171	ORINS. Gmelin, AED-CONF-64-003-110
CONF-489–	**(5th International Symposium on the Reactivity of Solids, Munich, Aug. 1964)**	
2	18-40046	See BNL-7666
3	18-40971	See BNL-7683
4	18-39989	See BNL-7696
CONF-502–	**(International Congress of Nuclear Physics, Paris, July 1964)**	
2	18-40221	See BNL-7973
19	18-40506	See IS-878
CONF-506–	**(Symposium on Compounds of Interest in Nuclear Reactor Technology, Boulder, Colo., Aug. 1964)**	
1	18-39821	See IS-875
3	18-39820	See IS-845
4	18-39897	See IS-848
CONF-520–	**(Conference on Mass Spectrometry, Paris, Sept. 1964)**	
1	18-39057	Dep.(mn); $1.00(cy), 1(mn) OTS
CONF-539–	**(Canadian Nuclear Association Conference on Canada's Role in a World of Expanding Nuclear Industry, Toronto, May 1964)**	
6	18-41006	ORINS
7	18-40919	ORINS
8	18-41005	ORINS
9	18-41008	ORINS
10	18-39837	ORINS
11	18-41003	ORINS
12	18-41002	ORINS
13	18-39512	ORINS
14	18-39836	ORINS
15	18-41007	ORINS
16	18-41004	ORINS
17	18-40918	ORINS
CONF-550–	**(The International Conference on High-Energy Physics, Dubna, Aug. 1964)**	
13	18-40254	See UCRL-11556
14	18-40240	See UCRL-11423
16	18-40245	See UCRL-11440
20	18-40250	See UCRL-11499
21	18-40246	See UCRL-11443
23	18-40253	See UCRL-11543(Rev.)
24	18-40226	See BNL-8234
25	18-40244	See UCRL-11429
26	18-40242	See UCRL-11427
30	18-40251	See UCRL-11516
31	18-40241	See UCRL-11424(Rev.)
32	18-40222	See BNL-8230
33	18-40224	See BNL-8232
34	18-40225	See BNL-8233
35	18-40227	See BNL-8235
36	18-40228	See BNL-8237
37	18-40223	See BNL-8231
38	18-40230	See BNL-8240
39	18-40232	See BNL-8242
40	18-40231	See BNL-8241
42	18-40092	See UCRL-11426
43	18-40247	See UCRL-11445
44	18-40248	See UCRL-11464
46	18-40380	See CAR-882-6
47	18-40255	See UCRL-11577
48	18-39612	See BNL-8249
49	18-39626	See UCRL-11425(Rev.)
50	18-40243	See UCRL-11428(Rev.)
51	18-40229	See BNL-8239
CONF-554–	**(Cryogenic Engineering Conference, Philadelphia, Aug. 1964)**	
3	18-40980	See LADC-6411
4	18-40981	See LADC-6412
6	18-40978	See LADC-6347
7	18-40979	See LADC-6410
8	18-39627	See UCRL-11558
CONF-558–	**(Radiation Processing Symposium, Buffalo, N. Y., May 1964)**	
2	18-39360	ORINS. Gmelin, AED-CONF-64-068-3
CONF-561–	**(Symposium on Inhaled Radioactive Particles and Gases, Richland, Wash., May 1964)**	
5	18-38772	ORINS. Gmelin, AED-CONF-64-049-11
CONF-571–	**(American Chemical Society 148th National Meeting, Chicago, Aug.-Sept. 1964)**	
5	18-39153	See BNL-8039
6	18-39152	See BNL-8038
9	18-39276	See BNL-8188
CONF-593–	**(Conference on the Automatic Acquisition and Reduction of Nuclear Data, Karlsruhe, Ger., July 1964)**	
4	18-39624	See UCRL-7905-T
CONF-622–	**(Institute of Environmental Sciences 1964 Technical Meeting, Philadelphia, Apr. 1964)**	
3	18-39420	ORINS. Gmelin, AED-CONF-64-047-5
4	18-39474	ORINS. Gmelin, AED-CONF-64-047-6
CONF-626–	**(American Physical Society, New York State Section Spring Meeting, Corning, New York, Apr. 1964)**	
1	18-40084	ORINS. Gmelin, AED-CONF-64-076-1
CONF-629–	**(7th National Power Instrumentation Symposium, Denver, May 1964)**	
1	18-40920	ORINS. Gmelin, AED-CONF-64-062-1
CONF-630–	**(Conference on Non-Linear Processes in the Ionosphere, Boulder, Colo., Dec. 1963)**	
1	18-40436	ORINS. Gmelin, AED-CONF-63-274-1
2	18-40173	ORINS. Gmelin, AED-CONF-63-274-2
3	18-40732	ORINS. Gmelin, AED-CONF-63-274-3
CONF-631–	**(Institute of Electrical and Electronics Engineers Region 6 Annual Conference, Salt Lake City, Apr.-May 1964)**	
1	18-39599	ORINS. Gmelin, AED-CONF-64-058-1
CONF-637–	**(Institute of Electrical and Electronics Engineers Region 3 Annual Meeting and Technical Conference, Clearwater, Fla., May 1964)**	

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1	18-39596	ORINS. Gmelin, AED-CONF-64-057-10
2	18-39597	ORINS. Gmelin, AED-CONF-64-057-11
3	18-39598	ORINS. Gmelin, AED-CONF-64-057-6
4	18-39804	ORINS. Gmelin, AED-CONF-64-057-8
5	18-39419	ORINS. Gmelin, AED-CONF-64-057-9
6	18-40220	ORINS. Gmelin, AED-CONF-64-057-7
CONF-644–	**(7th National Heat Transfer Conference, Cleveland, Aug. 1964)**	
1	18-39453	ORINS
2	18-39456	ORINS
3	18-39450	ORINS
4	18-39457	ORINS
5	18-39458	ORINS
7	18-39460	ORINS
8	18-39454	ORINS
9	18-39455	ORINS
10	18-39452	ORINS
12	18-39459	ORINS
13	18-39451	ORINS
CONF-646–	**(American Society of Agricultural Engineers 1964 Annual Meeting, Fort Collins, Colo., June 1964)**	
1	18-39718	Dep.(mn); $1.00(cy), 1(mn) OTS
CONF-648–	**(American Society of Limnology and Oceanography 27th Annual Meeting, Miami Beach, Fla., June 1964)**	
1	18-38773	Dep.(mn); $1.00(cy), 1(mn) OTS
CONF-649–	**(12th Annual Conference on Mass Spectrometry and Applied Topics, Montreal, June 1964)**	
1	18-39568	See LA-DC-6242
2	18-39600	ORINS. Gmelin, AED-CONF-64-093-4
3	18-39148	ORINS. Gmelin, AED-CONF-64-093-5
4	18-39149	ORINS. Gmelin, AED-CONF-64-093-6
5	18-39601	ORINS. Gmelin, AED-CONF-64-093-2
CONF-650–	**(Linear Accelerator Conference, Madison, Wis., July 1964)**	
1	18-40086	See LA-DC-6527
2	18-40087	See LA-DC-6528
3	18-40089	See LA-DC-6553
4	18-40088	See LA-DC-6542
5	18-40090	See LA-DC-6561
CONF-651–	**(9th International Conference on Low Temperature Physics, Columbus, Ohio, Aug.-Sept. 1964)**	
1	18-40047	See LA-DC-6463
2	18-40438	See LA-DC-6460
3	18-40439	See LA-DC-6554
4	18-40437	See IS-979
5	18-40440	See TID-21048
CONF-652–	**(American Industrial Hygiene Association Pacific Northwest Section Meeting, Richland, Wash., Aug. 1964)**	
2	18-40042	See HW-SA-3685
CONF-653–	**(American Chemical Society Symposium, Chicago, Sept. 1964)**	
1	18-39163	See LA-DC-6402
2	18-39822	See LA-DC-6401
CONF-654–	**(American Nuclear Society Meeting, San Francisco, Nov.-Dec. 1964)**	
1	18-40748	See BNL-8281
CONF-655–	**(Symposium on Analytical Instrumentation, Windscale, Cumb., Eng., Dec. 1964)**	
1	18-39056	See AERE-R-4474
CONF-656–	**(9th Annual Minerals Symposium, Moab, Utah, May 1964)**	
1	18-39400	ORINS. Gmelin, AED-CONF-64-079-7
CONF-657–	**(4th Annual Photovoltaic Specialists Conference, Cleveland, June 1964)**	
1	18-40036	ORINS. Gmelin, AED-CONF-64-087-1
2	18-40037	ORINS. Gmelin, AED-CONF-64-087-2
CONF-658–	**(National Telemetering Conference, Los Angeles, June 1964)**	
1	18-39602	ORINS. Gmelin, AED-CONF-64-089-1
CONF-661–	**(The Southwestern IEEE Conference and Electronics Show, Dallas, Apr. 1964)**	
1	18-40218	ORINS. Gmelin, AED-CONF-64-085-2
2	18-40219	ORINS. Gmelin, AED-CONF-64-085-1
CONF-662–	**(24th National Convention of Society for Nondestructive Testing, Philadelphia, Oct. 1964)**	
1	18-39466	See LA-DC-6289
CONF-664–	**(American Society for Testing Materials Symposium on Radiation Effects in Space, Atlantic City, N. J., June 1963)**	
1	18-39991	See D2-90407
CONF-666–	**(AEC Contractor Nuclear Materials Management Meeting, Gatlinburg, Tenn., Oct. 1964)**	
1	18-40211	See K-D-1833
CONF-667–	**(2nd International Symposium on the Physiology of Digestion in the Ruminant, Ames, Iowa, Aug. 1964)**	
1	18-38993	See HW-SA-3693
CONF-668–	**(Electron Microscope Society of America 22nd Annual Meeting, Detroit, Mich., Oct. 1964)**	
1	18-39998	See HW-SA-3673
CONF-669–	**(Conference on Particle Physics, Boulder, Colo., June-July 1964)**	
1	18-40249	See UCRL-11493
CONF-670–	**(Annual AEC Meeting on Industrial Safety and Fire Protection, Idaho Falls, Idaho, July 1964)**	
1	18-39530	See HW-SA-3631
COO–		
30-92	18-40321	Phys. Rev., 136: B281-5(1964)
712-73	18-39565	Dep.; $4.00(cy), 3(mn) OTS
1177-16	18-39426	Dep.(mn); $5.00(cy), 3(mn) OTS
CPNL-WI–	**(Belgian)**	
63/3	18-39613	Dep.(mn)
CRFD–	**(Canadian)**	
1178	18-39990	Dep.; $1.50(AECL)
CVNA–	**(Misc.)**	
210	18-40825	Dep.(mn); $3.00(cy), 2(mn) OTS
D–	**(Misc.)**	
2-90407	18-39991	$2.60(OTS)
DASA–	**(Misc.)**	
1409	18-40051	See RM63TMP-25
1507	18-40050	See RM64TMP-17
DESY–	**(German)**	
64/10	18-40233	Dep.(mn)
DP–		
901	18-39810	Dep.; $1.00(cy), 1(mn) OTS
DPST–		
64-83-7	18-40751	Dep.(mn); $1.00(cy), 1(mn) OTS
EGG–		
1183-2000	18-39235	Phys. Rev., 136: A243-4(1964)
ER–	**(Misc.)**	
8	18-40661	See NP-14233
6044	18-40214	See APL-TDR-64-92
ETR–	**(Belgian)**	
66	18-39570	See NP-8520
69	18-40957	See NP-8519
81	18-39843	See NP-9807
84	18-39371	See NP-10418
89	18-39370	See NP-10416
92	18-40812	See NP-10375

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93	18-40813	See NP-10417
98(Rev.)	18-39377	See NP-12549
115	18-39372	See NP-11851
117	18-39373	See NP-11916
120	18-39376	See NP-12345
123	18-39375	See NP-12246
125	18-39374	See NP-12244
129	18-39378	See NP-12619
141	18-39379	See NP-13396
EU–	**(German)**	
B33	18-39915	For translation see EURAEC-1105
EUR–	**(European Atomic Energy Community)**	
516.e	18-40888	Ingenieur (Utrecht), 75: No. 11, 39-49 (1963)
541.d	18-39855	See EURAEC-848
1608.f	18-39811	Dep.(mc)
1643.e	18-40973	Dep.(mc)
1653.d	18-39133	Z. Anal. Chem., 201: No. 1, 20-9(1964)
1689.d	18-38914	Z. Vererbungslehre, 95: No. 1, 17-24 (1964)
1830.e(Pt.I)	18-40826	Dep.(mc)
1830.e(Pt.II)	18-40827	Dep.(mc)
1830.e(Pt.III)	18-40828	Dep.(mc)
1843.e	18-39792	Dep.(mn)
1881.e	18-38774	Dep.(mn)
EURAEC–		
663	18-39463	Dep.(mn); $1.00(cy), 1(mn) OTS
762	18-39464	Dep.(mn); $1.00(cy), 1(mn) OTS
848	18-39855	Dep.(mn); $4.00(cy), 2(mn) OTS
1007	18-39862	Dep.(mn); $4.00(cy), 3(mn) OTS
1021	18-39856	Dep.(mn); $1.00(cy), 1(mn) OTS
1027	18-39614	Dep.(mn); $1.00(cy), 1(mn) OTS
1041	18-39838	Dep.(mn); $1.00(cy), 1(mn) OTS
1105	18-39915	Dep.(mn); $1.00(cy), 1(mn) OTS
1107	18-39857	Dep.(mn); $1.00(cy), 1(mn) OTS
1108	18-39812	Dep.(mn); $1.00(cy), 1(mn) OTS
1110	18-39894	Dep.(mn); $2.00(cy), 1(mn) OTS
1116	18-39839	Dep.(mn); $1.00(cy), 1(mn) OTS
1117	18-39858	Dep.(mn); $1.00(cy), 1(mn) OTS
1118	18-39863	Dep.(mn); $1.00(cy), 1(mn) OTS
1119	18-39916	Dep.(mn); $1.00(cy), 1(mn) OTS
1120	18-39917	Dep.(mn); $1.00(cy), 1(mn) OTS
1147	18-39430	See NYO-3114-2
1157	18-39994	Dep.(mn); $3.00(cy), 2(mn) OTS
1160	18-39814	See GEAP-4532
1175	18-40829	Dep.(mn); $1.00(cy), 1(mn) OTS
1181	18-39840	See GEAP-4521
1182	18-40807	See GEAP-4264
1188	18-40808	See GEAP-4704
EXP-NRX–	**(Canadian)**	
2906	18-39990	See CRFD-1178
FZK–	**(Non-AEC)**	
9-193	18-40001	See NARF-63-17T
9-195	18-40002	See NARF-63-19T
GA–	**(Misc.)**	
3087	18-39995	
4072	18-40830	Dep.(mn); $3.00(cy), 2(mn) OTS
4350	18-40831	Dep.(mn); $3.00(cy), 2(mn) OTS
4699	18-40908	Nucl. Sci. Eng., 20: 201-18(1964)
5377	18-40832	Dep.(mn); $1.00(cy), 1(mn) OTS
GEAP–	**(Misc.)**	
4264	18-40807	Dep.(mn); $6.00(cy), 4(mn) OTS
4462	18-39813	Dep.; $2.00(cy), 1(mn) OTS
4521	18-39840	Dep.(mn); $2.00(cy), 1(mn) OTS
4532	18-39814	Dep.(mn); $1.00(cy), 1(mn) OTS
4704	18-40808	Dep.(mn); $2.00(cy), 1(mn) OTS
GEMP–	**(Misc.)**	
38A	18-39815	Dep.; $1.00(OTS)
296	18-39895	Dep.(mn); $1.00(cy), 1(mn) OTS
298	18-39615	Dep.; $2.00(cy), 1(mn) OTS
304	18-40925	Dep.(mn); $3.00(cy), 2(mn) OTS
GMX–		
2-R-64-2	18-39164	See LA-DC-6595
GN–	**(Italian)**	
37	18-40833	Dep.(mn)
HASL–		
145	18-39487	Dep.; $2.00(cy), 1(mn) OTS
HW–		
66017	18-39816	$1.00(cy), 1(mn) OTS
68600-41	18-40974	Dep.; $2.00(cy), 1(mn) OTS
75072	18-39157	$1.00(cy), 1(mn) OTS
75521	18-40809	Dep.(mn); $1.00(cy), 1(mn) OTS
77380	18-40956	Dep.(mn); $1.00(cy), 1(mn) OTS
77531	18-39817	Dep.(mn); $1.00(cy), 1(mn) OTS
77906	18-39158	Dep.; $1.00(cy), 1(mn) OTS
78897	18-40922	Dep.(mn); $1.00(cy), 1(mn) OTS
78987(Rev.)	18-39365	Dep.; $1.00(cy), 1(mn) OTS
79770	18-39072	Anal. Chem., 36: 2065-7(1964)
79793	18-39996	Dep.; $1.00(cy), 1(mn) OTS
80253	18-40834	Dep.; $3.00(cy), 1(mn) OTS
80658	18-39841	Dep.(mn); $1.00(cy), 1(mn) OTS
81302(Rev.1)	18-40752	Dep.(mn); $2.00(cy), 1(mn) OTS
81423	18-40943	Dep.(mn); $1.00(cy), 1(mn) OTS
81950	18-39366	Dep.(mn); $1.00(cy), 1(mn) OTS
81964	18-39280	Dep.; $2.00(cy), 1(mn) OTS
82263	18-39997	Dep.; $1.00(cy), 1(mn) OTS
82631	18-39896	Dep.; $2.00(cy), 1(mn) OTS
HW-SA–		
3631	18-39530	Dep.(mn); $1.00(cy), 1(mn) OTS
3672	18-39367	Dep.(mn); $4.00(cy), 2(mn) OTS
3673	18-39998	Dep.(mn); $1.00(cy), 1(mn) OTS
3685	18-40042	Dep.(mn); $1.00(cy), 1(mn) OTS
3693	18-38993	Dep.(mn); $2.00(cy), 1(mn) OTS
IA–	**(Non-AEC)**	
855	18-39787	Radiochim. Acta, 2: 197-201(1964)
IDO–		
14607	18-39412	Dep.; $2.00(cy), 1(mn) OTS
14641	18-39368	Dep.; $1.00(cy), 1(mn) OTS
16977	18-40944	Dep.; $3.00(cy), 2(mn) OTS
16995	18-40505	Dep.; $3.00(cy), 2(mn) OTS
16997	18-40945	Dep.; $2.00(cy), 1(mn) OTS
17010	18-40946	Dep.; $3.00(OTS)
24455	18-40947	Dep.(mn); $2.00(cy), 1(mn) OTS
24458	18-40948	Dep.(mn); $4.00(cy), 3(mn) OTS
24461	18-39818	Dep.(mn); $4.00(cy), 3(mn) OTS
28616	18-40835	Dep.; $6.00(cy), 4(mn) OTS
IFA–	**(Rumanian)**	
30-IS	18-39779	Dep.(mn)
IFA-IS–	**(Rumanian)**	
31	18-39566	Dep.(mn)
IITRI–	**(Misc.)**	
B244-18	18-39859	
B6019-5	18-39819	
N213-20	18-39465	
IOI–	**(Canadian)**	
265	18-40765	Dep.; $1.00(AECL)
IPPJ–	**(Japanese)**	
26	18-40658	Dep.(mc)
27	18-40659	Dep.(mn)
IS–		
579	18-39921	Chem. Eng. Progr., Symp. Ser., 60: 68-75(1964)
822	18-39159	Dep.; $3.00(cy), 2(mn) OTS
838	18-40124	J. Am. Chem. Soc., 86: 3493-8(1964)
845	18-39820	Dep.(mn); $2.00(cy), 1(mn) OTS
848	18-39897	Dep.(mn); $1.00(cy), 1(mn) OTS
875	18-39821	Dep.(mn); $2.00(cy), 1(mn) OTS
878	18-40506	Dep.(mn); $1.00(cy), 1(mn) OTS
883	18-40975	Dep.; $3.00(cy), 2(mn) OTS

Report No.	Abstract No.	Availability
893	18-40976	Dep.; $3.00(cy), 2(mn) OTS
920	18-39232	Phys. Rev., 136: A175-89(1964)
929	18-39898	Dep.; $1.00(cy), 1(mn) OTS
950	18-39050	Dep.; $1.00(cy), 1(mn) OTS
979	18-40437	Dep.(mn); $1.00(cy), 1(mn) OTS
JINR-P–	**(Russian)**	
1760	18-40290	Nukleonika, 9: 147-54(1964)
JPRS–	**(Non-AEC)**	
26001	18-40011	$2.00(OTS)
26065	18-39918	$1.00(OTS)
26278	18-38717	$2.00(OTS)
JüL–	**(German)**	
160-NP	18-40475	Dep.(mn)
K–		
1617	18-39160	Dep.; $2.00(cy), 1(mn) OTS
K-D–		
1833	18-40211	Dep.(mn); $1.00(cy), 1(mn) OTS
K-L–		
1559	18-39161	Dep.(mn); $2.00(cy), 1(mn) OTS
KAPL–		
2251	18-39999	Dep.(mn); $1.00(cy), 1(mn) OTS
3020	18-40507	Dep.(mn); $3.00(cy), 1(mn) OTS
3061	18-40781	Dep.(mn); $1.00(cy), 1(mn) OTS
KR–	**(Norwegian)**	
68	18-39369	Dep.(mn)
84	18-40782	Dep.(mn)
87	18-40783	Dep.(mn)
LA–		
1209	18-40212	Dep.(mn); $2.00(cy), 1(mn) OTS
1356(Del.)	18-40213	Dep.(mn); $1.00(cy), 1(mn) OTS
2942	18-39899	Dep.; $6.00(cy), 4(mn) OTS
3046	18-39162	Dep.; $3.00(cy), 2(mn) OTS
3101	18-39842	Dep.; $1.00(cy), 1(mn) OTS
LA-DC–		
5757	18-40463	p.480-514 of "Progress in Low Temperature Physics." Amsterdam, North-Holland Publishing Co., 1964
6017	18-40977	Dep.(mn); $1.00(cy), 1(mn) OTS
6100	18-39970	Trans. AIME, 230: 962-6(1964)
6242	18-39568	Dep.(mn); $1.00(cy), 1(mn) OTS
6264	18-40836	Dep.(mn); $1.00(cy), 1(mn) OTS
6265	18-40837	Dep.(mn); $1.00(cy), 1(mn) OTS
6289	18-39466	Dep.(mn); $2.00(cy), 1(mn) OTS
6347	18-40978	Dep.(mn); $2.00(cy), 1(mn) OTS
6368	18-39187	Inorg. Chem., 3: 1231-6(1964)
6371	18-39248	Science, 145: 924(1964)
6401	18-39822	Dep.(mn); $1.00(cy), 1(mn) OTS
6402	18-39163	Dep.(mn); $1.00(cy), 1(mn) OTS
6410	18-40979	Dep.(mn); $1.00(cy), 1(mn) OTS
6411	18-40980	Dep.(mn); $1.00(cy), 1(mn) OTS
6412	18-40981	Dep.(mn); $1.00(cy), 1(mn) OTS
6442	18-39868	Metal Progr., 86: No. 3, 91-4(1964)
6460	18-40438	Dep.(mn); $1.00(cy), 1(mn) OTS
6463	18-40047	Dep.(mn); $1.00(cy), 1(mn) OTS
6470	18-40115	Science, 145: 918-19(1964)
6527	18-40086	Dep.(mn); $1.00(cy), 1(mn) OTS
6528	18-40087	Dep.(mn); $1.00(cy), 1(mn) OTS
6542	18-40088	Dep.(mn); $1.00(cy), 1(mn) OTS
6553	18-40089	Dep.(mn); $1.00(cy), 1(mn) OTS
6554	18-40439	Dep.(mn); $1.00(cy), 1(mn) OTS
6561	18-40090	Dep.(mn); $1.00(cy), 1(mn) OTS
6595	18-39164	Dep.(mn); $3.00(cy), 2(mn) OTS
LAMS–		
774	18-40508	Dep.(mn); $1.00(cy), 1(mn) OTS
938	18-40509	Dep.(mn); $1.00(cy), 1(mn) OTS
3092	18-39900	Dep.; $3.00(cy), 1(mn) OTS
3111	18-40926	Dep.; $2.00(cy), 1(mn) OTS
LAS-TR–	**(Misc.)**	
161-67	18-39565	See COO-712-73
MIT–	**(Misc.)**	
2098-56	18-39952	Phys. Rev., 136: A133-7(1964)
ML-TDR–	**(Non-AEC)**	
64-1	18-39616	$2.00(OTS)
64-194	18-39859	See IITRI-B244-18
MLM–		
907	18-40510	Dep.(mn); $1.00(cy), 1(mn) OTS
1189	18-40982	Dep.; $3.00(cy), 1(mn) OTS
1211	18-40983	Dep.; $1.00(cy), 1(mn) OTS
MR-N–	**(Non-AEC)**	
306	18-40000	See NARF-63-11T
NAA-SR–		
6319	18-40927	Dep.(mn); $3.00(cy), 2(mn) OTS
7785	18-40838	Dep.; $3.00(cy), 2(mn) OTS
7913	18-40839	Dep.; $3.00(cy), 1(mn) OTS
8448	18-39051	Dep.; $2.00(cy), 1(mn) OTS
9252	18-40928	Dep.(mn); $3.00(cy), 3(mn) OTS
9364	18-40736	Dep.(mn); $2.00(cy), 1(mn) OTS
9488	18-40840	Dep.; $4.00(cy), 2(mn) OTS
9503	18-40476	Dep.; $2.00(cy), 1(mn) OTS
9510	18-40841	Dep.; $1.00(cy), 1(mn) OTS
9637	18-40810	Dep.; $2.00(cy), 1(mn) OTS
9745	18-39617	Dep.; $1.00(cy), 1(mn) OTS
9762	18-39404	Dep.; $3.00(cy), 2(mn) OTS
9772	18-40784	Dep.; $1.00(cy), 1(mn) OTS
9801	18-40929	Dep.; $3.00(cy), 2(mn) OTS
9924	18-39467	Dep.; $2.00(cy), 1(mn) OTS
9943	18-40842	Dep.; $4.00(cy), 3(mn) OTS
NAA-SR-Memo–		
3848	18-39901	Dep.(mn); $1.00(cy), 1(mn) OTS
9337	18-40930	Dep.(mn); $1.00(cy), 1(mn) OTS
9475	18-39902	Dep.(mn); $2.00(cy), 1(mn) OTS
9523	18-40843	Dep.(mn); $1.00(cy), 1(mn) OTS
9555(Rev.)	18-40811	Dep.(mn); $1.00(cy), 1(mn) OTS
9560	18-40984	Dep.(mn); $3.00(cy), 2(mn) OTS
9605	18-40844	Dep.(mn); $2.00(cy), 1(mn) OTS
9639	18-40845	Dep.(mn); $2.00(cy), 1(mn) OTS
9664	18-39427	Dep.(mn); $2.00(cy), 2(mn) OTS
9685	18-39569	Dep.(mn); $1.00(cy), 1(mn) OTS
9686	18-39618	Dep.(mn); $1.00(cy), 1(mn) OTS
9721	18-39794	Dep.(mn); $1.00(cy), 1(mn) OTS
9741	18-40846	Dep.(mn); $2.00(cy), 1(mn) OTS
9749	18-39823	Dep.(mn); $1.00(cy), 1(mn) OTS
9787	18-39428	Dep.(mn); $1.00(cy), 1(mn) OTS
9800	18-40754	Dep.(mn); $3.00(cy), 2(mn) OTS
9802	18-40477	Dep.(mn); $3.00(cy), 2(mn) OTS
9829	18-40847	Dep.(mn); $1.00(cy), 1(mn) OTS
9837	18-40755	Dep.(mn); $2.00(cy), 1(mn) OTS
9844	18-39903	Dep.(mn); $1.00(cy), 1(mn) OTS
9905	18-39904	Dep.(mn); $1.00(cy), 1(mn) OTS
9947	18-40931	Dep.(mn); $2.00(cy), 2(mn) OTS
NARF–	**(Non-AEC)**	
63-11T	18-40000	$2.00(fs), $0.50(mf) OTS
63-17T	18-40001	$4.00(fs), $0.75(mf) OTS
63-19T	18-40002	$3.00(fs), $0.75(mf) OTS
NASA-TN–	**(Misc.)**	
D-2039	18-39824	$1.00(OTS)
D-2040	18-39825	$2.00(OTS)
D-2402	18-40418	$1.00(cy) OTS
D-2454	18-39795	$1.75(OTS)
D-2470	18-40048	$0.75(cy) OTS
D-2476	18-40660	$0.75(cy) OTS
D-2484	18-40118	$1.00(OTS)
NDA–	**(Misc.)**	
10-51	18-39429	Dep.(mn); $3.00(cy), 2(mn) OTS
NIJS-R–	**(Yugoslavian)**	
417	18-39281	Dep.(mc)
NIRL-R–	**(British)**	
65	18-39796	Dep.(mn)
68	18-39797	Dep.(mn)

Report No.	Abstract No.	Availability
NORA–	**(Norwegian)**	
17	18-40782	See KR-84
18	18-40783	See KR-87
NP–	**(AEC File No. for Non-AEC Reports)**	
8519	18-40957	Dep.(mn); $1.00(cy), 1(mn) OTS
8520	18-39570	Dep.(mn); $1.00(cy), 1(mn) OTS
9115(Pt.C)(Vol.I)	18-40848	Dep.(mn); $6.00(cy), 5(mn) OTS
9115(Pt.C)(Vol.II)	18-40849	Dep.(mn); $7.00(cy), 6(mn) OTS
9115(Pt.C)(Vol.III)	18-40850	Dep.(mn); $5.00(cy), 4(mn) OTS
9115(Pt.C)(Vol.IV)	18-40851	Dep.(mn); $6.00(cy), 6(mn) OTS
9115(Pt.C)(Vol.V)	18-40852	Dep.(mn); $6.00(cy), 5(mn) OTS
9807	18-39843	Dep.(mn); $2.00(cy), 1(mn) OTS
10375	18-40812	Dep.(mn); $1.00(cy), 1(mn) OTS
10416	18-39370	Dep.(mn); $1.00(cy), 1(mn) OTS
10417	18-40813	Dep.(mn); $1.00(cy), 1(mn) OTS
10418	18-39371	Dep.(mn); $1.00(cy), 1(mn) OTS
11851	18-39372	Dep.(mn); $2.00(cy), 1(mn) OTS
11916	18-39373	Dep.(mn); $1.00(cy), 1(mn) OTS
12244	18-39374	Dep.(mn); $1.00(cy), 1(mn) OTS
12246	18-39375	Dep.(mn); $1.00(cy), 1(mn) OTS
12345	18-39376	Dep.(mn); $2.00(cy), 2(mn) OTS
12549	18-39377	$1.00(cy), 1(mn) OTS
12619	18-39378	Dep.(mn); $1.00(cy), 1(mn) OTS
13396	18-39379	Dep.(mn); $2.00(cy), 1(mn) OTS
14127	18-39488	
14201	18-40234	Dep.(mn)
14205	18-40511	Dep.(mn)
14220	18-40985	Dep.(mn); $1.30(BIS), 6s. 6d. (HMSO)
14232	18-40049	
14233	18-40661	Dep.(mn)
14234	18-40932	
14239	18-40512	Dep.(mn)
14240	18-40235	Dep.(mn)
14241	18-40513	Dep.(mn)
14242	18-40236	Dep.(mn) Phys. Letters, 12: 151-3(1964)
14244	18-40237	Dep.(mn)
14246	18-40238	Dep.(mn)
14250	18-40853	Dep.(mn); $6.00(cy) OTS
14251	18-39052	
14252	18-40854	Dep.(mn); $2.00(cy), 1(mn) OTS
14253	18-40855	Dep.(mn); $1.00(cy), 1(mn) OTS
14255	18-39531	
14258	18-39532	
14259	18-40756	
14260	18-39059	
14268	18-39905	
14270	18-40856	Dep.(mn); $1.00(cy), 1(mn) OTS
14271	18-40857	Dep.(mn); $1.00(cy), 1(mn) OTS
14272	18-40858	Dep.(mn); $3.00(cy), 1(mn) OTS
14274	18-40859	Dep.(mn); $1.00(cy), 1(mn) OTS
14275	18-40860	Dep.(mn); $1.00(cy), 1(mn) OTS
14277	18-40861	Dep.(mn); $1.00(cy), 1(mn) OTS
14278	18-40862	Dep.(mn); $1.00(cy), 1(mn) OTS
14279	18-40863	Dep.(mn); $1.00(cy), 1(mn) OTS
14280	18-40864	Dep.(mn); $1.00(cy), 1(mn) OTS
14283	18-39476	
14285	18-40949	
14286	18-40865	
14287	18-40866	
14288	18-40950	Dep.(mn); $2.00(cy), 2(mn) OTS
14289	18-40951	Dep.(mn); $5.00(cy), 3(mn) OTS
14292	18-40986	
14293	18-40239	
14295	18-39571	Dep.(mn)
14317	18-39489	Dep.(mn)
14330	18-40381	
14335	18-40987	
14336	18-40091	Dep.(mn)
NPCC-FEWP–	**(British)**	
P.575	18-39905	See NP-14268
NRC–	**(Non-AEC)**	
62-90	18-40215	
8059	18-39179	Can. J. Chem., 42: 2137-8(1964)
NRL–	**(Misc.)**	
6053	18-40988	$1.75(OTS)
6085	18-40119	$2.00(fs), $0.50(mf) OTS
6127	18-40003	Dep.(mn); $0.50(cy), 1(mn) OTS
6141	18-39906	$0.50(cy), 1(mn) OTS
6150	18-39619	$0.50(cy), 1(mn) OTS
NRL-Memo–	**(Misc.)**	
1502	18-40004	Dep.(mn); $1.00(cy), 1(mn) OTS
NRS–	**(Australian)**	
17	18-39490	Dep.(mn)
NYO–		
3114-2	18-39430	Dep.(mn); $4.00(cy), 3(mn) OTS
3304-1	18-39431	Dep.(mn); $1.00(cy), 1(mn) OTS
9940	18-39432	Dep.; $5.00(cy), 4(mn) OTS
10216	18-39860	Dep.; $3.00(cy), 2(mn) OTS
10537	18-40867	Dep.(mn); $4.00(cy), 3(mn) OTS
10538	18-40868	Dep.(mn); $4.00(cy), 2(mn) OTS
10693	18-40514	Dep.; $3.00(cy), 2(mn) OTS
ONR–	**(Non-AEC)**	
16(Vol.1)	18-40989	$5.00(OTS)
ORNL–		
3584	18-40869	Dep.; $3.00(cy), 1(mn) OTS
3657	18-40757	Dep.; $3.00(cy), 2(mn) OTS
3660	18-39380	Dep.; $2.00(cy), 1(mn) OTS
3668	18-39907	Dep.; $1.00(cy), 1(mn) OTS
3674	18-39826	Dep.; $2.00(cy), 1(mn) OTS
3685	18-40766	Dep.; $2.00(cy), 1(mn) OTS
ORNL-CPX–		
1	18-40515	Dep.; Free(ORNL)
ORNL-IIC–		
1	18-40990	Dep.; $4.00(cy), 5(mn) OTS
ORNL-P–		
37	18-39382	Anal. Chem., 36: 2158-62(1964)
ORNL-RMIC–	**(Oak Ridge National Lab.)**	
3	18-39908	Dep.; Free(ORNL)
ORNL-TM–		
805	18-39709	Dep.(mn); $1.00(cy), 1(mn) OTS
882	18-40958	Dep.(mn); $2.00(cy), 1(mn) OTS
893	18-40814	Dep.(mn); $2.00(cy), 1(mn) OTS
918	18-40952	Dep.(mn); $2.00(cy), 1(mn) OTS
932	18-39413	Dep.(mn); $2.00(cy), 1(mn) OTS
ORNL-tr–		
221	18-40054	Dep.(mn); $1.00(cy), 1(mn) OTS; $1.10(fs), $0.80(mf) JCL
ORO–		
624	18-38775	Dep.; $4.00(cy), 3(mn) OTS
PAN–	**(Polish)**	
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